THE PLANT DISEASE BULLETIN

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THE PLANT DISEASE SURVEY

SUPPLEMENT 9

Diseases of Fruit Crops

in the United States in 1919.

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UNITED STATES DEPARTMENT OF AGRICULTURE

PLANT DISEASE SURVEY

1919

G. R. Lyman, Pathologist in Charge.

R. J. Haskell, Asst. Pathologist. G. H. Martin, Jr., Asst. Pathologist.

List of Collaborators of the Plant Disease Survey who have made the principal contribution to the 1919 annual summary.

It should be understood that many other collaborators and pathologists have assisted in gathering data within the states but the following list includes those who actually furnished state reports to the Washington office.

Alabama.....	Dr. G. L. Peltier
	Dr. E. F. Hopkins
Arizona.....	Prof. J. G. Brown
Arkansas.....	Dr. J. A. Elliott
	Prof. H. R. Rosen
Colorado.....	Prof. J. G. Leach
Connecticut...	Dr. G. P. Clinton
Delaware.....	Dr. T. F. Manns
	Prof. J. M. LeCato
Florida.....	Dr. H. E. Stevens
	Dr. C. D. Sherbakoff
Georgia.....	Prof. J. B. Berry
	Prof. J. A. McClintock
Idaho.....	Prof. C. W. Hungerford
Illinois.....	Dr. H. W. Anderson
	Dr. F. L. Stevens
	Prof. G. H. Dungan
Indiana.....	Dr. M. W. Gardner
	Prof. H. S. Jackson
	Dr. G. N. Hoffer
Iowa.....	Dr. I. E. Melhus
	Dr. R. O. Cromwell
Kansas.....	Prof. L. E. Melchers
	Prof. H. H. Haymaker
Kentucky.....	Dr. W. D. Valleau
Louisiana.....	Dr. C. W. Edgerton
Maine.....	Dr. W. J. Morse
Maryland.....	Prof. C. E. Temple
Massachusetts.	Prof. A. V. Osmun
	Mr. W. S. Krout
Michigan.....	Dr. E. A. Bessey
	Dr. G. H. Coons
	Mr. Ray Nelson
Minnesota.....	Dr. E. C. Stakman
	Dr. G. R. Bisby
Mississippi...	Prof. J. M. Beal
Missouri.....	Dr. W. E. Maneval
	Prof. C. H. Philpott
Montana.....	Prof. D. B. Swingle
	Dr. H. M. Jennison
	Prof H. E. Morris
Nebraska.....	Dr. E. M. Wilcox
Nevada.....	Prof. C. W. Lantz
New Hampshire...	Dr. O. R. Butler
New Jersey.....	Dr. M. T. Cook
New Mexico.....	Prof. L. H. Leonian
New York.....	Dr. Chas. Chupp
North Carolina..	Dr. R. A. Jehle
North Dakota....	Prof. H. L. Bolley
Ohio.....	Prof. A. D. Selby
	Prof. W. G. Stover
Oklahoma.....	Prof. C. D. Learn
Oregon.....	Prof. H. P. Barss
	Prof. C. E. Owens
Pennsylvania....	Prof. C. R. Orton
Porto Rico.....	Mr. Julius Matz
South Carolina..	Prof. J. L. Seal
South Dakota....	Prof. Manley Champlin
Tennessee.....	Prof. S. H. Essary
Texas.....	Dr. J. J. Taubenhaus
Utah.....	Dr. G. R. Hill, Jr.
Vermont.....	Dr. B. F. Lutman
	Prof. A. H. Gilbert
Virginia.....	Dr. F. D. Fromme
Washington.....	Dr. F. D. Heald
	Mr. B. F. Dana
	Mr. A. M. Frank
West Virginia...	Dr. N. J. Giddings
	Prof. Anthony Berg
	Dr. J. L. Sheldon
Wisconsin.....	Dr. R. E. Vaughan
	Prof. W. H. Wright

DISEASES OF FRUIT CROPS IN THE UNITED STATES

IN 1919

Prepared by
Lee M. Hutchins* and R. J. Haskell.

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FOREWORD

Sources of Information.

The summary of fruit diseases as they occurred in 1919 has been prepared by utilizing reports received by the Plant Disease Survey from various sources as follows:

1. Reports of collaborators, whose names are listed on the opposite page. Practically all of these persons replied to questionnaires submitted to them at intervals during the growing season and the majority of them sent in annual reports at the close of the year. It is to be regretted, however, that annual reports were not received from a number of important agricultural states, namely, Maine, Massachusetts, New York, Maryland, Michigan, Montana, Wyoming, Arizona, Utah, and Oregon. The information at hand from the important fruit state of California was also extremely meager.

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*Office of Fruit Disease Investigations, temporarily transferred to the Plant Disease Survey.

2. Reports of specialists in the Bureau of Plant Industry, particularly in the Office of Fruit Disease Investigations. Noteworthy contributions appear in subsequent pages from M. B. Waite, C. L. Shear, Charles Brooks, J. W. Roberts, W. S. Ballard, D. F. Fisher, and R. B. Wilcox, and valuable suggestions were made by H. R. Fulton and O. F. Burger.

3. Reports of food products inspectors of the Bureau of Markets. The certificates of these inspectors, of whom there are nearly 50 in number located in about 24 of the larger cities, are available to the Survey for examination. Certain data pertaining to losses were extracted and the results are presented, for the most part in tabular form, in the following pages.

4. Miscellaneous reports and records of the Plant Disease Survey. Abstracts were made from correspondence, news letters, papers, etc., and some, but not all, of the most recent publications giving 1919 data have been examined.

Methods and Estimates.

In writing these summaries the following order was usually used in arranging data for each disease:

1. Geographical distribution
2. Economic importance
3. Dates of first appearance
4. Varietal susceptibility
5. Control

In the case of some important diseases, accumulated reports over a period of several years were used as the basis for a general summary of occurrence, importance and varietal resistance. It is the intention of the Survey to include similar reviews of other diseases from time to time along with current year summaries.

Statistics on crop production in 1919 were taken from the Monthly Crop Reporter, Vol. 5, Dec. 1919, of the Bureau of Crop Estimates. In the calculation of percentages and losses it has been necessary generally to adopt the state as the unit, because both crop production figures and collaborators' reports are calculated in that unit, and not by counties. In maping the distribution and relative prevalence of a given disease, however, an attempt was made to ignore state boundaries wherever reports and other sources of information were sufficiently in detail to make it possible.

The estimates of losses are largely those of collaborators, or are compiled from an accumulation of their reports. These estimates are necessarily rough, but after carefully comparing reports from adjacent territories and submitting the data to pathologists who are specialists on the disease in question, it is felt that the figures are conservative. In writing these summaries an attempt has been made to pay particular attention to the important fruit producing sections, and to correlate severity of the various diseases with the importance of the crop in those sections.

Reports on well known diseases from regions of usual occurrence have been accepted, with occasional modifications of estimates where it seemed necessary. Considerable responsibility, however, is connected with the reporting of a disease for the first time in the United States, or with noting initial occurrence in a new locality or on an unusual host. When coming from reliable sources, such reports have been included in this summary, but persons interested should take up the matter of verification with the pathologist making the report. The Survey has not in all cases checked such reports with specimens and cannot take the responsibility for their accuracy unless specifically stated.

Where sufficient data were at hand, estimates of total losses from a given disease have been tabulated, but in the case of many important diseases causing indirect losses this has been impossible. Notably is this true with such devitalizing diseases as root rots, crown gall, apple powdery mildew in the West, and peach leaf curl. Confusion in estimates from two or more diseases affecting the same fruit has necessarily resulted in some duplication, particularly in the case of reports of inspectors of the Bureau of Markets.

Names of varieties have been made to conform with official nomenclature, and when reported under a synonym the latter is given in parenthesis.

Suggestions for 1920.

Observance of the following suggestions would enable the Survey to improve the summary next year. Failure of collaborators in some important territories to file reports has frequently caused embarrassment in estimating losses. All collaborators are urged to prepare their reports, and to make them as timely, accurate and complete as possible. Reports of occurrence and relative prevalence by counties is of great assistance in plotting distribution maps. The symbols recommended by the Survey are as follows:

⊛ = very severe
\+ = severe
V = medium
\- = slight
Θ = very slight

In the case of such diseases as black rot of the apple, for example, which may affect limbs, foliage, and fruit, it would often clarify reports if the nature of the attack was specified. Also in giving dates of first appearance, which are very valuable, it should be recorded in what county or town the disease was observed and what parts of the plant were affected. In reporting varietal susceptibility care should be taken to give comparative data on plants which are reasonably comparable in age and vigor.

The Survey takes this opportunity to state that credit for any service which may be derived from this summary is largely due to the careful and painstaking reports of collaborators in several important states, and to numerous notes and criticisms given by pathologists of the Office of Fruit Disease Investigations of the United States Department of Agriculture.

DISEASES OF POME FRUITS

APPLE

Scab caused by Venturia inaequalis (Cke.) Wint.

Favored by early and continued rains together with cool temperatures which prevailed over most of the eastern and central apple growing regions for about one month after the blooming period, apple scab, in 1919, appeared in many states with unprecedented severity and resulted in enormous losses.

The disease was unusually severe in the Upper Mississippi Valley, the Great Lakes region and the Appalachian fruit belt from Pennsylvania to North Carolina and Tennessee, and extended over parts of the Coastal Plain. Prevalence of scab over these regions is reported as follows by collaborators: Minnesota (Bisby) - Unusually common and severe. Wisconsin (Vaughan) - More scab than for several seasons. Michigan (Coons) - Exceedingly prevalent in spite of dry weather, experienced an enormous loss. Illinois (Anderson) - Bad throughout state, caused exceptional foliage injury. Indiana (Gardner) - Most severe apple disease in Indiana this year, although blossoms and young fruits suffered heavily, infection of older fruits not as bad as might have been expected. Ohio (Selby) - Scab much worse than usual, general over whole state. Pennsylvania (Orton) - Apparently general throughout state, most serious outbreak in several years, 100% infection in Cumberland, Huntingdon, and Center counties. New York (Chupp) - More severe than usual. Delaware - General throughout state, very common on early varieties in spite of vigorous spraying. Virginia (Fromme) - Unusually severe, scabbiest year in history of apple industry in the state. West Virginia (Giddings) - More prevalent than any year since 1909. Tennessee (Essary) - Unusually severe this season. Missouri - The disease is more abundant south of the Missouri River, but pretty well controlled in sprayed orchards.

Of the New England states, Massachusetts (Osmun) reported scab more prevalent and severe than for several years. In Maine losses were reported extensive and severe June 6, but less severe July 1. Vermont reported much less than average due to dry summer. New Hampshire - Moderately abundant. Connecticut (Clinton) - Somewhat more pronounced than for normal season.

The southern tier of apple producing states from Oklahoma and Arkansas to South Carolina suffered as usual a loss of about 1% - very much less than their neighbors to the north. Arkansas (Elliott) reported scab well controlled in commerical orchards, loss about 1/2%.

West of the 100th meridian apple scab was reported as follows in 1919: Montana - Scab of little consequence this year. None in sprayed orchards, some losses locally in unsprayed orchards. Idaho (Hungerford) - Very little scab in northern Idaho as compared with former years; injury 0.5%, loss 0.2%. No scab noted anywhere in southern Idaho in June. Washington (Heald) - Scab very common and severe in western Washington, very little in eastern Washington - less prevalent than usual, and none in central irrigated Washington. Oregon (Barss) - Moist weather of early June resulted in some scab development, but crop appears in general to be rather clean. California - Apple scab is known to be widely distributed in this state, but no statement of losses has been reported to the Survey in recent years. In 1903 Newton B. Pierce stated: "This disease has caused considerable loss in California in 1903, its present distribution largely covers the apple growing districts of the state", and again in 1905 Pierce reported: "The disease gradually spreading to all apple sections (California)".

Other interior western states reported as follows in 1919: Colorado (Leach) - "Have observed none this year." New Mexico - None observed, believed not to be present. Arizona - Reported absent from every county in the state.

M. B. Waite, United States Department of Agriculture, comments as follows upon the occurrence of apple scab in 1919:

"From field observations in parts of Maryland and Virginia adjacent to Washington, and in the Shenandoah Valley of Virginia, and from conversation with fruit growers, specimens and correspondence, data have accumulated to show a very unusual outbreak of apple scab from New Jersey to North Carolina. The district in question includes the entire Appalachian Fruit Belt and the Piedmont Plateau, as well as adjacent sections on the Coastal Plain, particularly towards the north. It is probably the worst outbreak of apple scab for thirty years or perhaps that has ever been reported. Similar outbreaks have occurred in New York and New England, the Great Lakes apple orchards, and in the Upper Mississippi Valley in previous seasons, but never before so bad generally in this district.

"As an indication of the severity of this attack, examples of scab attacking the fruit of the York Imperial turned up quite generally from this district, and in some instances, the fruit of this variety was damaged to the extent of 25% by this disease. This is unprecedented. Previous to 1919, the writer had personally seen the disease on the York Imperial fruit in out a few scattered instances. Twice it was found at Winchester, Virginia on small, greenish York Imperial fruits in the autumn and on less than a dozen specimens. The trees from which these came were badly attacked by cedar rust. At the time it was thought that these delicate, thin-skin York Imperial fruits, resulting from cedar rust attacks, were thus rendered much more susceptible to the scab fungus, and it may be suggested as a possibility that the resistance of the York Imperial to scab may have been reduced by cedar rust to some extent. The foliage of York Imperial has always been relatively susceptible to the scab, but not the fruit. That reduced vitality from cedar rust is not the main factor in this outbreak, however, is obvious since the Winesap, Stayman Winesap, Paragon or Mammoth Black Twig, (the Winesap Group), not attacked by cedar rust have been in this outbreak, as usual, badly attacked by the scab. Rome, Yellow Newtown, Ben Davis and many other varieties have been severely injured by scab in the region mentioned during the past year.

"While this apple scab outbreak was bad on the Coastal Plain in New Jersey and the Delaware-Chesapeake peninsula, some observations at certain points on the Coastal Plain in Maryland and Virginia showed a small amount of apple scab even under these remarkable infection conditions. I think I can now recall that scab has generally been slight on the Coastal Plain from Baltimore southward, except on the Delaware-Chesapeake peninsula, which is inclined to be cooler and moister, but the fact that in Maryland scab was abundant in the Piedmont region and scarce on the Coastal Plain at points less than twenty miles apart, deserves notice. I am inclined to attribute this to the lack of previous infection; in other words, there must have been few scab spores to make use of the unusual infection conditions.

"The main reason for this great outbreak of apple scab can be directly attributable to the unusual weather conditions in late April and during the month of May. The accumulation of scab during previous years was evidently a factor, but there was altogether too much rainy, cloudy and damp weather during an entire month, beginning about the time the apple trees came into bloom. For example, the official Weather Bureau meteorological records at Washington, D. C., beginning April 24 and ending May 24 show only three periods with clear weather - one clear day April 24, two clear days ~~April~~ May 2 and 3, and two clear days ~~April~~ May 18 and 19. During this period of thirty-one days, there were rains on twenty-one days, counting those in which a trace is recorded, and a trace is probably as effective on cloudy days as a heavier rain, not to mention the heavy dews with which the fruit and foliage were saturated on other cloudy days. Of the twenty-one days with rain, only six were marked "partly cloudy", which means that the sun shone through the clouds part of the time. The other fifteen days were cloudy all day. Of the ten days in which no rain fell, five only have already been accounted for as clear. Of the remaining five days, two were cloudy and three were partly cloudy.

"It is evident that there was almost a continuous infection period for thirty-one days, beginning when the apple trees were in bloom in the middle portion of this region, slightly preceding bloom in the northern sections, but following closely after bloom in the southern sections, and in general, occurring at the most dangerous period from the standpoint of apple scab. This is plainly the most important factor in the outbreak."

For corrected percentage losses by states from apple scab in 1919 see Plant Disease Bulletin, Supplement 12, 1920. Reports covering practically all of the apple producing regions east of the 100th meridian, representing 67% of the total apple production of the country in 1919, indicate that the apple crop over this area suffered a loss of more than 5 1/2%, or in the neighborhood of 5,760,000 bushels from scab. About one-half of this loss occurred in New York, Pennsylvania, Michigan and Wisconsin, where local losses from scab were not far from 10%. About one-fourth of it occurred in the central states from Missouri to Virginia and North Carolina where local losses by states ran from 3% to 6%. Perhaps one-eighth of it occurred in New England, New Jersey and Delaware. Less than 1 1/2% occurred in the southern tier of apple states from Oklahoma and Texas to South Carolina.

Western apple production (west of the 100th meridian) amounted in 1919 to about 33% of the total apple crop of the country. Of this amount, one-third, or roughly 11% of the total United States crop was subjected to more or less loss from apple scab in California, Oregon and western Washington. Two-thirds of the western apple crop in 1919, or roughly 22% of the total United States crop for that year was produced in central and eastern Washington, Idaho, Montana, Colorado, Utah, Arizona, and New Mexico, where losses from scab were from zero to a trace.

Out of 2973 cars of apples inspected at destinations by Bureau of Markets inspectors, 46 cars were found to be affected with scab as follows:

Table 20. Losses as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with scab	Average percentage of scab	Range of percentage of scab	Remarks as to seriousness of scab.
Arkansas	1	17	15-20%	Badly scabbed.
Canada	1	9	8-10%	
Colorado	1	2	2%	Slightly scabbed.
Delaware	2	16	11-22%	
Illinois	3	10	10%	
Kansas	1	9	8-10%	
Maine	1	5	5%	Slightly scabbed.
Maryland	3	25	15-35%	Badly scabbed.
Massachusetts	1	8	8%	
Michigan	10	16	3 cars 28-43%	Badly scabbed. includes other blemishes in estimates.
			7 cars 2-20%	Other blemishes included also.
New York	11	20	2 cars 50-80%	Scab appears in small spots.
			9 cars 2-22%	Bad scab in some cars.
Oregon	1	33	33%	Mostly in small spots.
Pennsylvania	1	3	3%	Badly scabbed.
Virginia	6	18	9-30%	Other blemishes included in estimates.
West Virginia	3	22	1 car 55%	Scab found in small spots.
			2 cars 4-6%	Slightly scabby.

Varietal susceptibility in 1919 was reported as follows by collaborators:

Susceptible

Connecticut:	McIntosh	Pennsylvania (cont.):	Star - (More than usual)
	Crab		Transparent (10%)
	Martha		
		Virginia:	Winesap family
New York:	Ben Davis		Yellow Newtown
	"Greening"		Arkansas
	King		Delicious
	Northern Spy		Stayman Winesap
	McIntosh		Limbertwig
			Virginia Beauty
Pennsylvania:	Stayman Winesap		Paragon
	Delicious		Ben Davis
	Gano		
	Banana	Missouri:	Winesap family
	Jonathan		June
	King		Jonathan
	Grimes (More than usual)		Gano
			Ben Davis

Resistant

New Hampshire:	Baldwin (Generally free)	Connecticut:	Baldwin Russet
Virginia:	York Imperial (Slight to no infedtion) Grimes	New York:	Baldwin Russet Wealthy
Missouri:	Rome		Oldenburg

Control of apple scab in 1919 was commented on by collaborators as follows:

Massachusetts: (Osmun) Many cases of spray injury traceable to primary injury by Venturia inaequalis.

New York: Early plowed orchards gave best control. Orchards sprayed thoroughly with pink spray are very clean. Spraying about three times the general practice in commercial orchards.

Pennsylvania: Forty percent of fruit infected, 100% on susceptible varieties - usually associated with neglect in applying pink blossom spray.

Delaware: Vigorous spraying did not control scab on early varieties.

Virginia: Proper spraying gave satisfactory control; heavy loss in Shenandoah Valley attributed to fact that "pink" spray was not applied.

West Virginia: Best results with Bordeaux.

Tennessee: Held in check by spraying.

Ohio: Bordeaux pre-blossom spray excellent. Much loss through abandonment of Bordeaux sprays for lime-sulphur.

Indiana: Bordeaux spray fairly successful, sulphur dust not reliable.

Illinois: (Anderson) Regular lime-sulphur sprays when properly applied gave good control.

Michigan: Carefully sprayed - satisfactory; carelessly sprayed - heavy loss; unsprayed - no first class fruit.

Wisconsin: Lime-sulphur has proven to be better than Bordeaux chiefly because less russeting, pre-pink spray gave best results.

Minnesota: Controlled by dusting and spraying in experimental plots.

Iowa: Ordinary spraying not fully effective.

Missouri: Pretty well controlled in orchards where spraying is practical. Lime-sulphur or Bordeaux effective.

Arkansas: Unsprayed fruit badly damaged. Liquid sprays, including lime-sulphur, gave complete control.

Oregon: Bad only in orchards not properly sprayed.

Regarding the value of sulphur dust for the control of scab and other apple diseases collaborators have furnished the following opinions:

Connecticut: "Dusting seems to be coming in a little more than past years, but as yet is used in only a limited way. I know of one case where good results seemed to come from the use of sulphur dust in dusting apples for scab." Clinton.

Virginia: "Sulphur dust has given fair control of scab and was worthless for bitter-rot. With arsenate of lead it has proven the equal of liquid for codling moth. Bordeaux dust found worthless for bitter-rot but but very effective for blotch (Phyllosticta) and frog-eye leaf spot." Fromme.

West Virginia: "I may say that our opinion has not changed very much as to the value of sulphur dust. It certainly does not give good results for control of apple diseases this year, but I am still hoping that some good may come out of it." Giddings.

Arkansas: "A complete failure in the control of any disease of the apple. Orchards that have used dust for the last two or three years were almost ruined by bitter-rot this year." Elliott.

Michigan: "Probably controls scab in ordinary years."

Minnesota: "Valuable. Found about equal to Bordeaux in experimental tests." Bisby.

Referring to control of apple scab in 1919 in the Applachian Fruit Belt, the Piedmont Plateau, and adjacent sections of the Coastal Plain, M. B. Waite makes the following statement:

"The full apple scab spray treatment has not ordinarily been necessary in this region, and even the better sprayed orchards were usually given only the calyx spray and the two later sprays. In two cases near Vienna, Virginia, orchards given this routine treatment and sprayed thoroughly gave excellent commercial results. In Montgomery county, Maryland, a group of orchards, either dusted at the time of the calyx spray with arsenates or unsprayed, resulted in very severe losses."

Errett Wallace, United States Department of Agriculture, submits the following statement concerning the control of apple scab:

"In our tests for the past nine or ten years lime sulphur solution combined with lead arsenate has been used in comparison with practically all types of fungicides which have been advocated for this disease, and thus far we have found nothing better, all things considered, at least for the localities in which our work has been conducted. It has given

satisfactory control under the worst epidemic conditions and caused less injury both to fruit and foliage than any other equally effective preparation."

Bitter rot caused by Glomerella cingulata (Stonem) S. & S.

Since 1903 bitter rot of the apple has been reported at least once from every state east of the Mississippi River except Vermont and Florida. All of the states bordering the Mississippi on the west have reported it, also Nebraska, Kansas, Oklahoma, Texas, and New Mexico.

A conservative average of the percentage losses by states to the total apple crop from bitter rot during the past seventeen years, as indicated by the reports filed during that period, makes it possible to divide the area where bitter rot is known into five relative groups. The accompanying map indicates this grouping at a glance. In states where losses are heaviest for the group, a "+" replaces the "*".

Group	I.	Occurrence, losses negligible.
Group	II.	Average annual losses for group about 4.5%
Group	III.	" " " " " " 2.0%
Group	IV.	" " " " " " 5.5%
Group	V.	" " " " " " 12.0%

Fig. 22. States grouped according to average percentage losses from bitter rot.

Group I, in which losses are negligible to slight and of small importance, will be seen to include New England, New York, New Jersey, Delaware, Michigan, Wisconsin, Minnesota, Iowa, Nebraska, Kansas, Oklahoma, and Texas. Massachusetts and New Jersey average slight to negligible losses, such losses in Massachusetts often affecting apples stored in bins. Iowa averages about 0.5%; Texas may run as high as 1%.

Group II includes Pennsylvania, Ohio, Indiana, Illinois, and Missouri. The first two states average about 4% loss and the figure is a trifle higher for Indiana and Illinois. Greatest loss for the group is sustained in Missouri. The principal loss is in southern part of these states.

Group III includes only West Virginia and Kentucky. Reports from Kentucky are very meagre, but indicate that losses may approximate 1.5%, while West Virginia reports consistently an average of about 2%. It is interesting to note this region of slight infection surrounded on all sides by areas of heavy infection. John W. Roberts comments upon this area as follows:

> "The difference in the percentage of bitter rot in Virginia and West Virginia is due largely to the fact that the Yellow Newtown is not grown to any extent in the latter state. Virginia's higher rate is due to the large plantings of this variety in the Piedmont section."

Group IV includes Maryland, Virginia, and Tennessee, where losses to the total apple crop in the respective states averages 5% for Maryland and Virginia and 6% for Tennessee.

Group V. South of the line marking the southern boundaries of Virginia and Tennessee is the region where heaviest percentage losses from bitter rot occur. In group V the following losses per year are very common: North Carolina 10%, South Carolina 15%, Georgia 10%, Alabama 10%, and Arkansas 8%.

> "Bitter rot is typically a disease of humid hot sections, extreme heat being especially favorable for its development. Those sections in which there are periods of extreme heat without appreciable temperature diminution at night with occasional showers or rainy periods are especially well situated for the development of bitter rot." (J. W. Roberts)

In estimating percentage losses the values given in Table 21, which follows, are considerably influenced by very heavy losses before the pathogene and its control was well understood in all important sections. For example, Selby reported 25% loss in Ohio in 1905 and 50% in certain localities in 1910. Arthur reported 40% loss in Indiana in 1905. Rolfs reported 40% injury in Missouri in 1906, 25% in 1910. With improved methods of control and the gradual elimination of extremely susceptible varieties, these estimates will no doubt continue to be reduced. Also with more accurate and complete reports, especially by counties and localities, instead of by states alone, the grouping by states here presented, may be rearranged. Not only is this true of bitter rot, but of other diseases as well.

The average annual loss given in the following table is sustained in the area included in groups II to V, which produces about 40% of the average total crop, and 30% of the average commercial crop of the country. About 60% of the normal total production and 70% of the normal commercial production of the country is free from this disease.

We may roughly estimate the average importance of bitter rot to the apple industry of the United States as follows:

Table 21. Average relative importance of bitter rot, production of 1918 used as basis.

Groups	Importance of area. Percentage of U. S. apple crop produced in 1918		Average percentage of total crop in area lost from bitter rot	Average percentage of total U. S. crop lost in area	Bushels lost
	Total	Commercial			
Apple producing states where bitter rot is not reported by collaborators	20	31	0	0	0
Group I - New England N.Y., N.J., Del., Mich. Wis., Minn., Iowa, Nebr., Kans., Okla., Tex.	40+	39	Negligible	Negligible	Negligible
Group II - Mo., Ill. Ind., Ohio, Pa.	20-	14	4.5	0.9	1,500,000
Group III - Ky., W.Va.,	5	4.5	2	0.1	170,000
Group IV - Md., Va., Tenn.	10+	9.5	5.5	0.55	930,000
Group V - Miss., Ala., Ga., S.C., N. C., Ark. (Av. loss 8%)	5+	2	12	0.6	1,000,000

An estimate of the average annual loss to the total U. S. apple crop from bitter rot amounts to about 2%, or in the neighborhood of 3,000,000 bu.

Regions of heaviest annual loss, according to the best of our knowledge, are shown by the heavily shaded portions of the accompanying map (Fig. 23). Isolated cases of severe infection, of course, occur outside this area. Appreciable losses, 2% or more, are liable to occur over the entire area indicated by shading and light lines. States in which losses are negligible are marked with an asterisk (*).

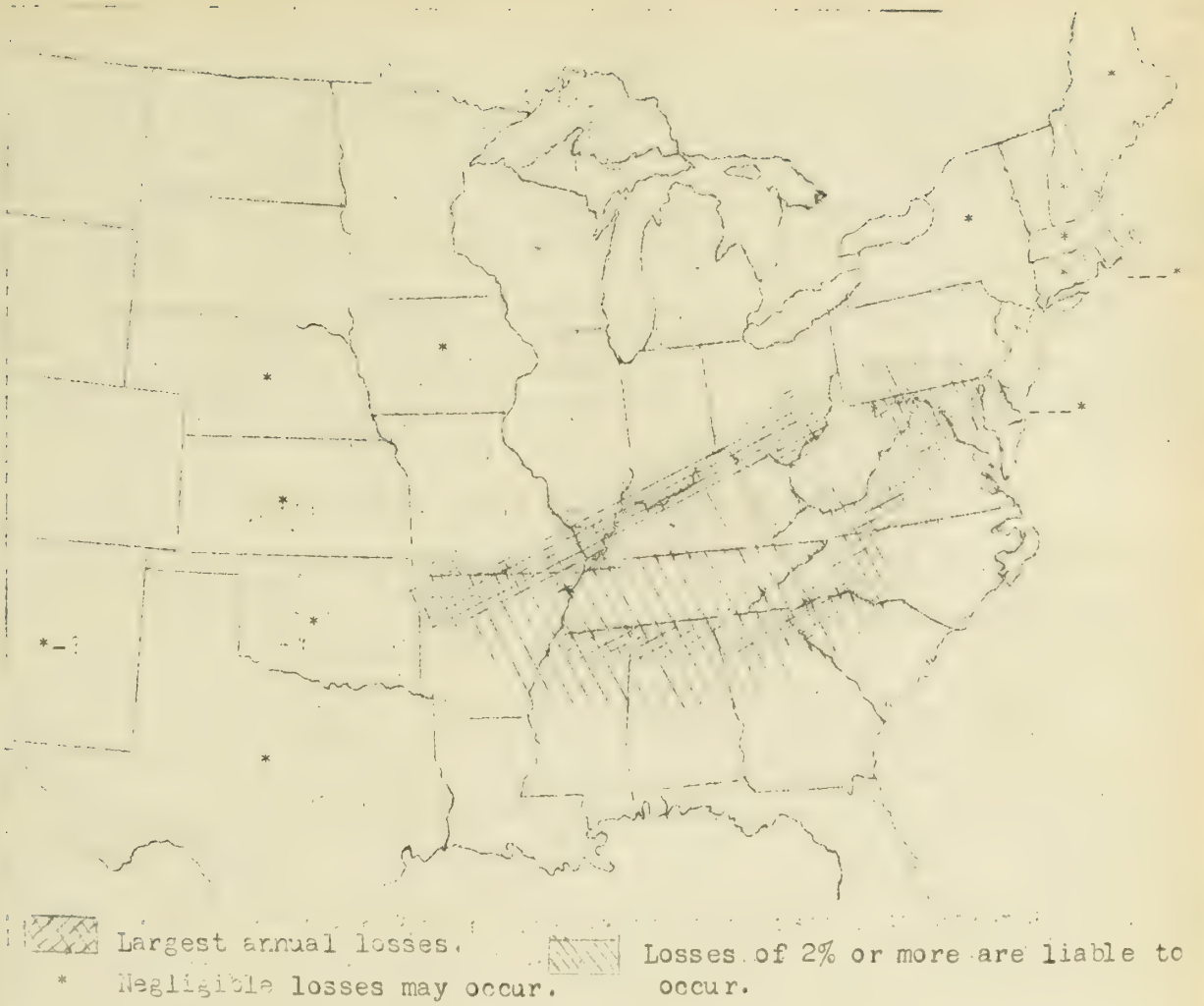

Fig. 23. The bitter rot belt.

Bitter rot in 1919

Collaborators' reports on the relative prevalence of bitter rot in 1919 indicate that in the northern tier of states, comprising Group I, where injury is negligible to slight, behavior of the disease was apparently about normal. Massachusetts reported: "More than usual, amount on both early and late varieties, not of great importance". New Jersey (Cook) reported: "More severe than usual". Michigan (Coons) reported: "No bitter rot found on Michigan fruit, common on Pennsylvania and Illinois apples shipped to Detroit". Texas reported 1% loss.

Group II reported uniformily 2 to 3% less damage than usual in 1919. Pennsylvania 1%, Ohio 1%, Indiana 1%, Illinois 1-½, Missouri 2%. Pennsylvania (Orton) stated that infection was local in Adams, Bucks, and Center counties. Ohio (Selby) reported this disease in southeastern Ohio, less severe than usual. Missouri (Haneval): "Generally distributed throughout state, percentage small to moderate."

Group III (Kentucky and West Virginia): Injury apparently less than usual. West Virginia (Giddings) reported injury as "Slight, 1%".

Group IV (Maryland, Virginia, and Tennessee). Virginia suffered an unusually severe attack for recent years. Fromme reported: "More prevalent and destructive than for several years, excessive rainfall, 5% loss, $500,000". Tennessee (Essary) reported: "Bitter rot is common, loss not so heavy as in previous seasons".

Group V (Arkansas, Mississippi, Alabama, Georgia, North Carolina, and South Carolina) in 1919 suffered their usual heavy loss from bitter rot. Arkansas (Elliot) reported: "Worst infection in several years, some orchards badly damaged, loss 5%, $225,000". Losses in Alabama were estimated at 7%. Georgia (Berry) 10%, South Carolina (Seal) 25%, North Carolina (Jehle) 5%.

Summary of losses from bitter rot in 1919.

Virginia and Arkansas -heavier than usual for recent years, 5% loss or - - - - - - - - - - - - - - - - - -	710,000 bu.
Pennsylvania, Ohio, Indiana, Illinois, Missouri, average 2 to 3% less loss than usual. Estimates are placed at 1%, which together with 1% loss in West Virginia, Kentucky, Tennessee, and Texas makes a total of -	300,000 "
North Carolina, South Carolina, Georgia, Alabama, and Mississippi probably lost in the neighborhood of -	220,000 "
	1,230,000 "

The estimates of losses from bitter rot in 1919 are thus seen to be about 1,230,000 bushels, or 0.84% of the total crop of the country.

Data received on varietal susceptibility, 1919

Massachusetts: More than usual amount on both early and late varieties.
Pennsylvania: Severe on Smith (Smith Cider), York Stripe, Stayman, Black Twig, Maiden Blush. Also infection on York Imperial.
Virginia: Susceptible - Yellow Newtown (especially susceptible)
Georgia: Susceptible - Early varieties more susceptible.
Ohio: Reported on Jonathan.
Missouri: Reported on Gano, Ben Davis, Rambo.
Arkansas: Early Harvest, Transparent, Gano, Ben Davis, Givens (especially susceptible), Jonathan, and nearly every other variety.

Dates of first appearance, 1919.

Pennsylvania	-	August 17	- Bucks County
Virginia	-	July 7	- Franklin County
Georgia	-	May 18	
Arkansas	-	June 25	

Control measures reported by states.

Virginia: (Fromme) Early appearance and continued rainfall made it a difficult disease to combat this year. Very satisfactory control with early thorough spraying. Early and thorough spraying with Bordeaux gave good control.

North Carolina: (Jehle) Usually controlled by spraying.

South Carolina: (Seal) Fair control when spray was used.

Ohio: (Selby) Control measures effective when applied in time. Copper sprays in July good.

Missouri: (Maneval) Spraying effective in control.

Arkansas: (Elliott) Worst infection in several years. Some orchards badly damaged, notably those which were dusted and where Bordeaux was not applied in July. Bordeaux and pruning effective.

Blotch caused by Phyllosticta solitaria E. & E.

Apple blotch, so far as known, occurs only in the Central and Southern states of the eastern half of the country. It has apparently not advanced beyond the northern borders of New Jersey, Pennsylvania, Ohio, Indiana, Illinois, and Iowa. One case was reported from a nursery in Wabasha county, Minnesota, in 1917 on imported nursery stock, but it is understood to have been eradicated. It is reported from a few localities in South Dakota, and is abundant in Nebraska, Kansas, Oklahoma, and Texas, but is not known to occur farther west.

During the period 1905-1907 apple blotch was causing heavy losses in Missouri and Arkansas and was reported as severe and increasing in southern Illinois. It was also very prevalent over the less important southern apple regions east of the Mississippi and south of Virginia, and was being noted in many nearby states farther to the north and west. From 1910 to 1912 reports of the appearance of blotch in new localities and of its rapid increase came from Oklahoma, Kansas, Nebraska, Iowa, Indiana, and Ohio. From 1912 to 1919 the progress of this disease in its advance northward is recorded by several of the states. Virginia (Fromme) 1917 - "Not common"; 1918 - "More reports than in any previous year"; 1919 - "The disease seems to be increasing rapidly in Virginia orchards. It may be found only on a tree here and there, but in a few cases is the most important pest". West Virginia, 1910 - "Small amount"; 1914 - "Believed to be increasing, destructive locally"; 1915 -"More abundant"; 1917 - "Occurs locally at several points, but not of great importance." Delaware, 1912 - "Two cases"; 1915 - "Fairly prevalent"; 1916 -"More prevalent"; 1917 - "More prevalent"; 1919 - "Increasing". Pennsylvania (Orton)- 1914 - "Likely to prove one of our worst apple diseases"; 1915 - "Increasing"; 1917 - "More than usual, the disease has been spreading rapidly the last three years"; 1918 - "On the increase every year, fast becoming one of the most serious apple diseases in Pennsylvania." Ohio (Selby) 1910 - "Reported for the

first time from 7 counties"; 1911 - "Collected from 16 counties"; 1914 - "More"; 1915 - "Epidemic in Ohio the past three years"; 1916 - "Rather more"; 1918 - "More, ranks second only to fire blight for its seriousness in Ohio. It has prevailed on a largely increasing number of varieties, one of the serious midsummer diseases of the apple." Indiana (Gardner) 1912 - "Getting to be a bad disease in the southern part of the state"; 1916 - "Quite common, southern part of the state"; 1919 - "Especially prevalent in the southern and central part, second disease in importance in this state this year (scab first)". Illinois 1907 - "Considerable"; 1912 - "Severe on certain varieties"; 1918 - "80% infection on Ben Davis in many sprayed orchards, losses of 10 to 30 per cent of the fruit common"; 1919 - "More serious than usual". Iowa 1909 - "In

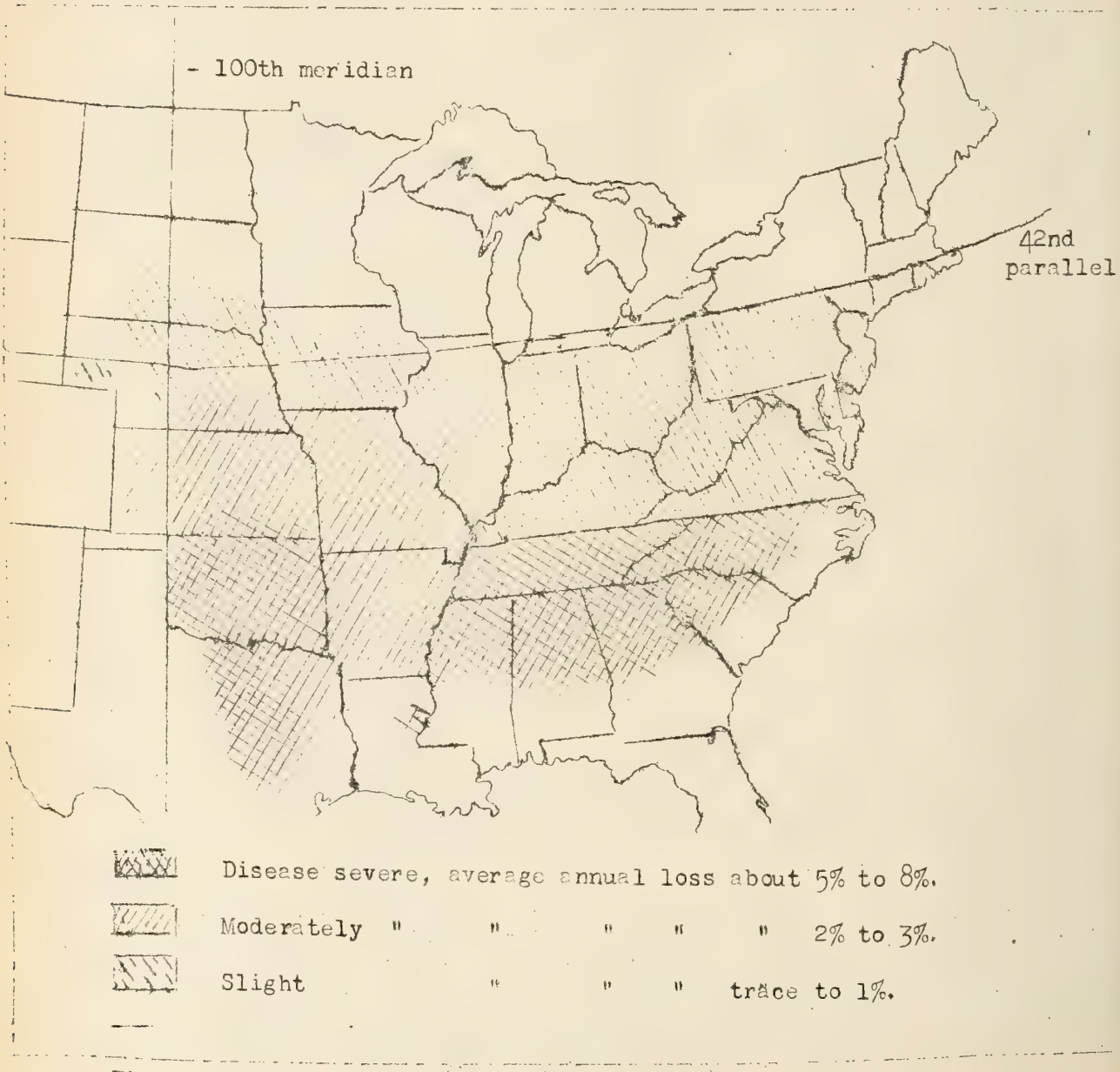

Fig. 24. Occurrence of apple blotch in the United States.

only one county"; 1912 - "On Northwestern Greening, spreading"; 1913 - "Common wherever Northwestern Greening is cultivated"; 1919 - "Severe on some varieties southwestern part of state". Nebraska 1910 - "Seems now to be one of our new Nebraska diseases"; 1914 - "Each year becoming more widespread"; 1919 - "Estimated loss to total crop for state 2%". Kansas 1910 - "Abundant"; 1916 - "Very bad in unsprayed orchards 4 to 5% of crop lost (in such cases)"; 1918 - "One of the most destructive diseases of summer apples the past season, difficult to find fruit of early varieties not affected with blotch, loss 10 to 66% (locally)". Average loss 3% total crop for state.

While it is possible that climatic influences may not favor the serious aggression of apple blotch beyond its present northern limits, New York and New England may be interested to know that the disease is reported from at least three northern tier counties of Pennsylvania (Susquehanna - 1913, 1917; McKean - 1915, 1917, 1918; Erie - 1918), and Michigan to note that her neighbors on the south have reported it in northern tier counties as follows: Ohio, Cuyahoga - 1911, 1919; Lucas - 1914, 1916; Lake - 1916; Lorain - 1919; Indiana, Laporte - 1916. Collaborators in states like New York and Michigan should maintain a close watch for initial appearances of this disease, especially in their southern counties.

The occurrence of apple blotch in the United States, as reported to date, is therefore remarkably well defined by the area lying south of the 42nd parallel and east of the 100th meridian. At the extreme northeast of this area the disease does not occur (New York and New England) and in the extreme northwest it extends a little further north. With the exception of the most northern portion of this area blotch is widely distributed, and on the whole very abundant. (See Fig. 24.)

Losses average around 1% in the states east of Illinois and north of Tennessee and North Carolina (only a trace in Delaware, New Jersey, and West Virginia), and are probably not over a trace to 1% in northern Iowa and South Dakota. Heaviest losses are sustained in Arkansas, Missouri, Illinois, Kansas, Oklahoma, Texas, and the states east of the Mississippi which lie south of Virginia. John W. Roberts, United States Department of Agriculture, states that apple blotch is at its worst and hardest to control in the vicinity of Wichita, Kansas.

For corrected percentage losses by states in 1919 see Plant Disease Bulletin, Supplement 12, 1920.

Table 22 shows the relative importance of blotch to the apple industry in 1919.

The greatest loss in bushels from blotch in 1919 was sustained in the states comprising group "B" (Illinois, Kansas, Nebraska, Missouri, Arkansas), where 12.1% of the total apple crop of the United States was produced, and 0.3% of it (442,000 bushels) lost from this disease. Of this group at least Arkansas and Missouri would be classed in group "A"(5 to 8% local loss) if good control measures were not employed. The eight states comprising group "A" (Oklahoma, Texas, Mississippi, Alabama, Georgia, Tennessee, North Carolina, South Carolina), while producing only one-third the quantity of apples, suffered almost as heavily in total bushels lost (412,000) as group "B". In this section blotch is very prevalent, and in many orchards control measures are not practiced. In group "C" (Pennsylvania, Maryland, Virginia, Ohio, Indiana, Kentucky, Iowa) where 18.7% of the total apple crop of 1919 was produced, and

where blotch is as yet scattered but is becoming annually more serious, 280,000 bushels were lost - or more than the combined losses of Nebraska, Missouri, and Arkansas from this disease. Sixty per cent of the apple production of the country (group "E") is entirely free from apple blotch.

Table 22. Losses from apple blotch in 1919. States grouped according to prevalence of disease.

Groups of states.	Character of injury	Percentage loss of total crop for area.	Importance of industry in area: % U.S. crop produced. Total	Com'l	Percentage of total U.S. crop lost in area from blotch	Bushels lost.
A. Okla. Tex. Miss. Ala. Ga. Tenn. N.C. S.C. (La. crop unimportant)	Severe	5% to 8%	4.6 -	1.3	0.28 +	412,000
B. (a) Ill. Kans.	Moderate	3%	4.6 -	4.6	0.15 -	221,000
(b) Nebr. Mo. Ark.	"	2%	7.5 +	9.0	0.15 +	221,000
C. Pa. Md. Va. Ohio, Ind. Ky. Iowa.	Slight	1%	18.7 +	12.5	0.19 -	280,000
D. N.J., Del. W.Va. S. D.	Trace	Less than 1%	4.6 +	5.4	Trace	----
E. 20 remaining apple-producing states.	None	0	60.0	67.2	0	0
Loss to total U. S. apple crop from blotch in 1919 - - -					0.77%	1,134,000 bu

Out of 2973 cars of apples inspected by the Bureau of Markets inspectors in 1919, at least 15 cars were found to be affected with blotch (Phyllosticta solitaria). In the following table this number is divided up according to the respective points of origin in view of the above grouping. It should be remembered that the markets inspections have only to do with commercial production, and therefore while losses from blotch are much greater locally in the states comprising group "A", for example, than from those in group "B", the latter group put more than ten times as much fruit as the former on the market.

Table 23. Losses from blotch (Phyllostieta solitaria) as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

	Total number of cars.	Average percentage of fruit affected.
Group A. (severe loss)		
Texas	2	26%
Group B. (moderate loss)		
Ill. - 2 cars		
Kans. - 2 cars		
Mo. - 1 car		
Ark. - 5 cars	10	18%
Group C. (slight loss)		
Virginia	1	3%
Origin unknown	1	3%

Susceptibility of varieties in 1919 was listed as follows by collaborators. No resistant varieties were mentioned.

Susceptible

Virginia:	Ben Davis	Indiana:	Northwestern Greening
	Limbertwig		Rhode Island (R.I.Greening)
	Northwestern Greening		Stark
	Rhode Island		Ben Davis
	Yellow Newtown		Smith (Smith Cider)
			Oldenburg (Duchess)
Illinois:	Oldenburg (Duchess)		Arkansas Red
	Ben Davis		
	Maiden Blush	Iowa:	Northwestern Greening

Varieties reported affected, susceptibility not given.

Delaware:	Smith (Smith Cider)	Illinois:	Grimes and Jonathan in region of heavy infection.
	Jonathan		Transparent
	Fourth of July		

The Yellow Newtown and Jonathan are generally considered resistant. J. W. Roberts states that in Arkansas the Jonathan variety is seldom sprayed for blotch.

Of the susceptible varieties the following are among the most severely attacked: Northwestern Greening, Smith, Missouri, Limbertwig, Ben Davis, Wagener, Willow, Maiden Blush.

The resistant are: Jonathan, Winesap, York Imperial.

Table 24. Susceptibility of apple varieties to blotch as reported by collaborators. Summary of reports from 1905 to 1919.

(Note: Frequently reports stated disease severe, without naming the susceptible and resistant varieties. Varieties underlined appear also in another class.)

Susceptible

Arkansas: Okla., '19

Arkansas Black:
Mo., '18
Okla., '17, '18

Arkansas Red: Ind., '19

Ben Davis:
Ill., '12, '18, '19
Ind., '19
Mo., '18
Nebr., '18
Okla. '17, '18, '19
Va., '18, '19

Bentley (Bentley Sweet):
Ohio

Black Twig: Pa., '17
Okla., '19

Colton (Early Colton):
Mo., '18

Cornell.

Delicious: Nebr., '18
(One report)

Early Cooper (Cooper's Early White):
Nebr., '18

Early Harvest: Mo., '18

Lwalt: Pa., '11

Gano: Okla., '17, '18, '19

Grimes (Grimes Golden):
Ohio, '14, '15, '16
Pa., '17

Krauser: Pa., '11

Limbertwig (Red Limbertwig):
N.C., '12, '15
Ohio, '18
Va., '19

Maiden Blush:
Ill., '19
Mo., '18, '19
Pa., '11, '18, '19

Mann: Ohio, '16, '18

Missouri (Missouri Pippin):
Ill., '12
Mo., '17, '19
Ohio, '18
Okla., '19

Northwestern Greening:
Ind., '19
Iowa, '12, '13, '19
Mo., '17, '18
Ohio, '15, '16, '18
Pa., '19
Va., '19

Oldenburg (Duchess):
Ind., '19
Ill., '19
Ohio, '18

Ralls (Genett) Nebr. '18

Red Astrachan: Va., '08

Rhode Island (Rhode Island Greening)
Ind., '19
Va., '19

Rome (Rome Beauty):
Ill., '12
N. C., '12

Smith (Smith Cider):
Del., '10, '19
Ind., '19
Mo., '05
N. J., '15, '16, '17, '18
Ohio, '14, '15, '16, '18
Pa., '11, '17, '18, '19

Stark:
Ind., '19
Ohio, '14, '16, '18
Pa., '11, '17, '18

Summer Rambo:
Ohio, '16

Wealthy: Mo., '18

White Pippin:
Mo., '18

Yellow Newtown:
Va., '19

Yellow Transparent:
Mo., '18

Wagener:
Ohio: '14, '15

Willow (Willow Twig):
Ind., '12
W. Va., 07.

Resistant

Baldwin: Ohio

Gano: Ohio "Less susceptible", (Bul. 333)

Grimes (Grimes Golden): Ohio, '18
"Less susceptible", (Bul. 333)

Jonathan: Okla., '17, '19
Ohio, (Bul. 333)

Milam: Mo., '18

Maiden Blush: Ohio, "Less susceptible", (Bul. 333)

Rhode Island (R. I. Greening);
Ohio, (Bul, 333)

Rome (Rome Beauty): Ohio, '18

Stayman Winesap: Ohio, (Bul. 333)

Wagener: Pa., '11

Wealthy: Pa., '11

Winesap:
Mo., '18
Okla., '17, '18
Ohio, (Bul. 333)

York Imperial:
Va., '18
Ohio, (Bul. 333)

Reported on, susceptibility not given

Ben Davis: Pa., '19

Colton (Early Colton): Mo., '17

Fourth of July: Del., '19

Gano: Mo., '19

Grimes (Grimes Golden): Ill., '19

Jonathan: Del., '19
Ill., '19
Mo., '19

McMahon: Mo. '19

Rambo: Chio

Roman Stem: N. J., '18

Yellow Transparent:
Ill., '19
Mo., '19

York Imperial: Pa., '19

Spraying with Bordeaux when properly applied seems to have given good results in 1919.

Results of spraying are reported by states as follows:

Arkansas: "Bordeaux good."

Georgia: "Thorough spraying protected the fruit."

Illinois: "Lime sulphur and Bordeaux gave good results, properly applied."

Indiana: "Bordeaux fairly successful, dust gave only a slight degree of control."

Missouri: "Spraying sometimes quite effective, in other cases results unsatisfactory."

Ohio: "Spraying Clermont County orchards in 1918 at three weeks' intervals following petal fall gave less than 50 per cent marketable fruit. Three applications of Bordeaux mixture in 1919 in several counties at intervals of two weeks, followed by an additional application in July, gave an average of over 90 per cent marketable fruit. Unsprayed trees in the same orchards gave less than 10 per cent marketable fruit in blotch areas. Sprayed trees bore more fruit and their apples were larger as a rule than those from unsprayed trees. No trees were sprayed on the three-weeks schedule in these trials." (Stover, Beach, Parks) (Abstracts - St. Louis Meeting).

Oklahoma: "Bordeaux gave fair to good control."

Tennessee: "It is controlled by spraying." (Essary)

Virginia: "Bordeaux 3 weeks after bloom fell gave good results. Bordeaux used for calyx spray gave excellent control, according to report, but russeted fruit. Bordeaux dust in experimental work gave most excellent results."

John W. Roberts, Fruit Disease Investigations, United States Department of Agriculture, recommends the following: Bordeaux, 3-4-50. The first spraying for this disease is the most important and should be finished three weeks after the petals have fallen. The second and third applications should follow at three weeks intervals. Roberts believes that 90% of the 1,134,000 bushels loss (see Table 22) could have been prevented by spraying.

Rust caused by Gymnosporangium juniperi-virginianae Schw.

Apple rust is distributed over the Atlantic States from Maine to Georgia, and extends westward as far as the outer boundaries of the non-irrigated apple belt. Extensive commercial production over this half of the country ceases at about the line of 18 inches annual precipitation, but rust is reported from scattered plantings practically up to the 100th meridian (see map). Collaborator J. G. Leach stated that through an error the disease was reported from Colorado in 1918. It is not found in the irrigated districts, nor in the humid regions of the Pacific Coast.

According to Charles Mohr, United States Department of Agriculture, (Division of Forestry, Bul. 31, 1901) the red cedar of the East, Juniperus virginiana, which serves as the alternate host for the apple rust fungus, is one of the most widely distributed and one of the most indifferent to soil and climate of any tree in the eastern half of the country.

"Its northern limit on the Atlantic Coast is in southern Nova Scotia, and in the interior on Lake Champlain. Toward the west the tree extends under nearly the same parallel (44° to 44° 30' N.) to the southern shore of Georgian Bay, to Northern Michigan, southern South Dakota, western Nebraska, and Kansas, and southward to the eastern bank of the Colorado River, near Austin in southeastern Texas. It thrives in the valley of the St. Lawrence and in New

England; on the hills and limestone flats of the Southern States; and on the exposed arid ridges of Kansas and Nebraska. It is, however, south of the 36th parallel that the red cedar is at its best.

"As has been shown by Prof. C. S. Sargent, the red cedar of the West, formerly considered identical with that of the East, is a distinct species, for which he proposed the name Juniperus scopulorum. Juniperus virginiana does not extend farther west than the basin of the Mississippi River in the North, and the eastern slope of the Colorado River Valley (eastern Texas) in the south."

The red cedar of the Gulf shore and eastern Florida is a distinct species - Juniperus barbadensis, so that the southern limits of Juniperus virginiana are probably "on the coast in lower South Carolina, and westward on the limestone hills in the upper division of the maritime pine belt in Alabama and Mississippi."

The relative prevalence of the apple rust fungus in the eastern half of the United States is very variable, depending upon distribution of cedars, introduction of the fungus, susceptible varieties of apple, and climate. The more prominent regions may be grouped as follows:

Group I. Large percentage losses to total crop.

(a) Virginia : Often a loss of perhaps 6 to 8% of the
North Carolina: total crop for these states.

(b) Tennessee :
Arkansas : Average losses probably not far from 2 to 3%
South Carolina:

Group II. Average losses to the total crop for the state in excess of a trace, but generally only moderate, perhaps 1% ordinarily.

(a) South Central Pennsylvania, Maryland, West Virginia (percentage higher in the Panhandle), Ohio River Valley.

(b) Southern Wisconsin, Minnesota.

(c) Western Iowa, Eastern Nebraska, Southeastern South Dakota.

(d) Northern parts of Georgia, Alabama, and Mississippi.

Group III. Rust occurs only locally, is in most cases only present and seldom causes more than a trace of damage.

(a) New England, very slight infection, occasionally prominent locally in Massachusetts.

(b) New York - Cedars are scattered over New York, but rust seems to be more common in the lower Hudson River Valley and in Central Long Island, where it may cause local losses of less than 1%.

(c) New Jersey - With New York in occasional slight local losses.

(d) Delaware - With New York in occasional slight local losses.

(e) Michigan - "Frequently in Michigan cedars and apples may be found growing in close proximity, but cedar rust is very rare, it is probably a question of the fungus not having been introduced." (Bessey)

(f) Missouri - Less than 1%; not at all serious.

(g) North Dakota, Kansas, Oklahoma, and Texas - No appreciable injury; disease merely present.

Group IV. States where apple rust is not reported to occur: Florida and all territory west of the 100th meridian.

The above estimates are an approximation only of the losses from apple rust based on reports covering the period 1903-1919. Figure 25 indicates in a general way the distribution and relative importance of the disease in the various states where it occurs.

Apple rust in 1919.

In 1919 apple rust occurred throughout the region of its usual distribution (outlined above) and was reported from no new localities. Reports from the Pacific Coast state that it does not occur there.

Continued rainfall prevailed over much of the eastern country during the spring and early summer, which greatly favored extensive infection of the young leaves in the regions where gall-bearing cedars are found in the vicinity of orchards. Heavy defoliation followed, which in some sections materially reduced the size of the crop.

The region in which heaviest losses were sustained in 1919 from apple rust includes: South Central Pennsylvania, the Panhandle of West Virginia, the Shenandoah Valley and Southwestern Virginia, North Carolina, Tennessee, and Arkansas. Virginia leads this group with a loss of 15% (valued at $1,500,000) to the total crop for the state. Fromme stated:

> "Greater loss than in any previous year - unusually favorable season for infection, few leaves escaped in exposed orchards. Late summer drought added to losses in further reducing size of fruit. No Yorks large enough for barreling in many orchards, largely sold for bulk or cider stock."

North Carolina reported 10% loss; Pennsylvania, West Virginia, Tennessee, South Carolina, and Arkansas sustained losses which they characterized as "severe" in localities, and which probably ran from 1% to 3% of the total crop. The northern parts of South Carolina, Georgia, Alabama, and Mississippi indicate considerable loss, although percentage losses are probably not above 1%. Apple rust in Eastern Nebraska and Southeastern Minnesota was important in 1919, causing its usual annual loss of from 1 to 2% of the crop.

Ohio, Indiana, Illinois, Missouri, and Iowa reported less damage than usual, amounting to about 1% in Ohio and not much more than a trace in the other states.

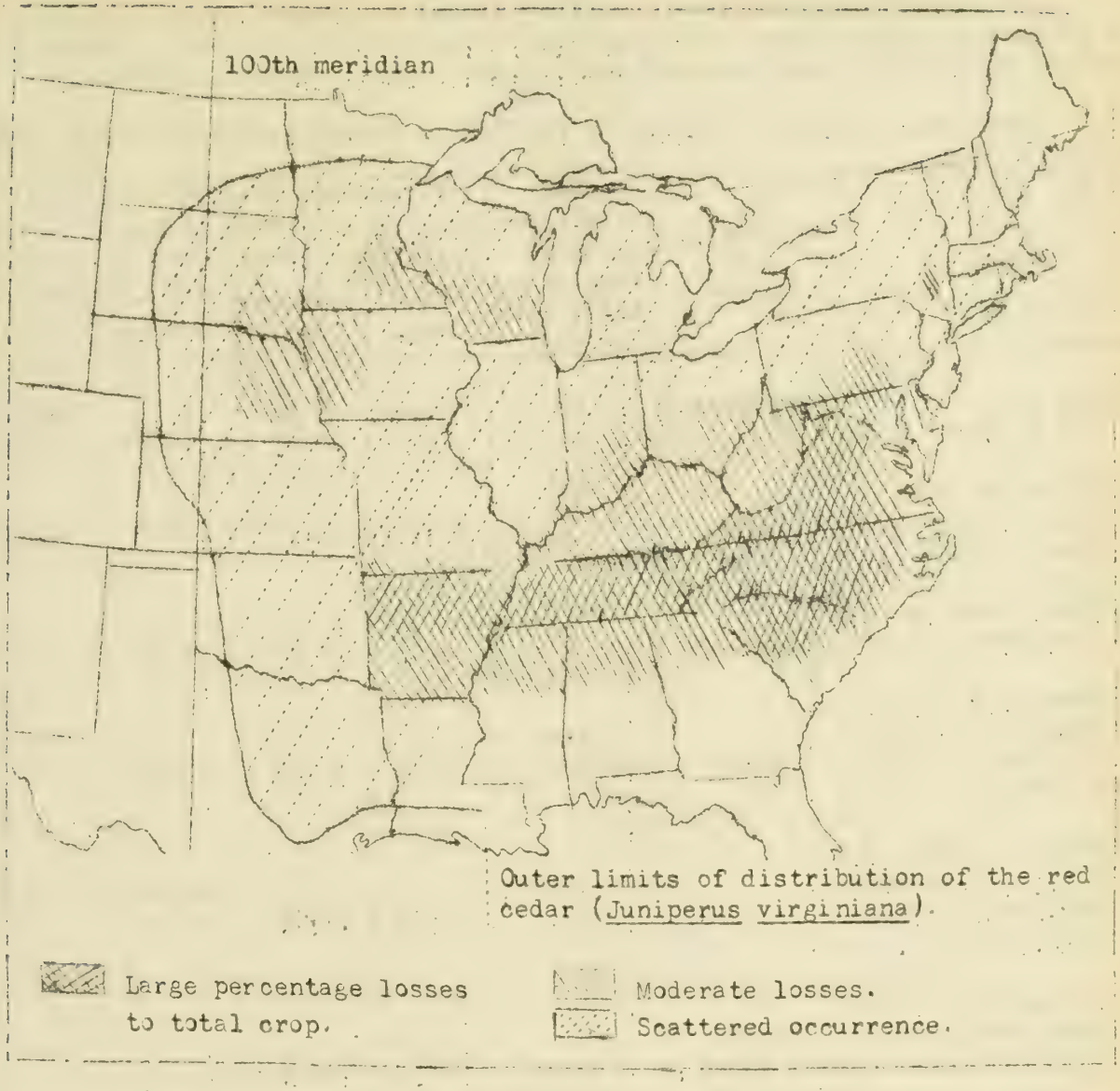

Fig. 25. Occurrence of apple rust in the United States.

M. B. Waite, United States Department of Agriculture, commented as follows upon the occurrence of apple rust in 1919:

"From personal observations, conversation with fruit growers, and reports by correspondence, apple cedar rust has been considerably worse than usual during the past season in the Appalachian Fruit Belt, including parts of Pennsylvania, Maryland, Virginia, West Virginia, and North Carolina. The disease is evidently on the increase, as it has been in these districts since 1908 when it became notably serious on the York Imperial in spots.

"In addition to the increase in the amount of infection, the unusual weather conditions of last spring, the excessive number of rainy and cloudy days occurring last spring, are undoubtedly an important factor in this outbreak. (See further under apple scab)."

For corrected percentage losses by states see Plant Disease Bulletin, Supplement 12, 1920. The following table is intended to give at a glance a general idea of the importance of rust to the apple industry for 1919.

Table 25. Summary of losses in the United States from apple rust, 1919.

Groups	Character of injury	Approximate percentage loss of total crop for area	Percentage of U. S. apple crop produced in area 1919		Percentage of total U. S. crop lost in this area from rust in 1919	
			Total	Com'l	Percent	Bushels
A. (a) Va.	Very severe	15	6.74	5.76	1	1,474,000
(b) N. Car.	" "	10	0.75	0.35	0.075	110,000
B. Pa., W.Va., Ky., Tenn., S.Car., Ark., & Nebr.	Severe	2	13.95	16.75	0.28	412,000
C. Md., Ohio, Ga., Ala., Minn., & Miss	Moderate	1	5.	2.74	0.05	73,000
D. Mass., N.Y., N.J. Del., Ind., Ill., Wis., Mo., S.Dak., & Iowa.	Trace	Less than 1	26.94	26.70	Trace	
E. Me., Vt., Conn., R.I., Mich., N.Dak. Kan., Okla., Tex., La., & Colo.	Rare	Negligible	14.86	13.09	Negligible	
F. Wash., Ore., Calif. Ida., Mont., Wyo., Utah, Nev., N.Mex., & Ariz.	Disease not known to occur	0	31.75	34.61	0	
United States					1.4%	2,064,000

It therefore appears that about 1.4% of the total apple crop of the country for 1919 or roughly 2,000,000 bushels was lost from rust, and that three-quarters of this loss occurred in Virginia alone.

Summary of distribution of losses, from data in preceding table.

Apple production in 1919		Losses from apple rust	
21%	(Groups A & B).....	Heavy	- 1.35%
5%	(Group C).....	Moderate	- 0.05%
27%	(Group D).....	Trace	- t
47%	(Groups E & F).....	No loss	- 0

Dates of first appearance in 1919, collaborators' reports

May 22..... Minn.	June 1 .....Iowa
May 28..... Ind.	June 5.....Tenn.
May 28..... Va.	June 14,.....Pa.
May --..... Ark.	June 15.....S. C.
May --..... Okla	June 26.....Mo.

Growing resistant varieties is manifestly a considerable factor in control.

Table 26. Susceptibility of varieties as given by collaborators, 1919

States	Susceptible	Moderate	Resistant
Arkansas	Jonathan	-	Winesap
	Ben Davis	-	-
Minnesota	Wealthy	-	Patten's Greening
			Northwestern Greening
Pennsylvania	York Imperial	-	-
Wisconsin	Wealthy	-	-
Virginia	York	Ben Davis	Winesap
	Rome Beauty	Northern Spy	Red June
	Shockley	Limbertwig	M. Black Twig
	Gravenstein	Fallawater	Stayman
	Missouri Pippin	Gano	Delicious
	Willow Twig	Lowry	Grimes
	Duchess		Virginia Beauty
	Jonathan		King David
			Baldwin

NOTE: Non-bearing trees suffer more injury to foliage than bearing trees.

Table 27. SUMMARY: of survey data from 1905 to 1919 on susceptibility of apple varieties to rust as reported by collaborators.

(Names underscored appear also in another column.)

Susceptible	Moderate	Resistant
Ben Davis: Ark. '19, Ia. '18, N.C. '12, Ohio '17, Pa. '17, Tenn. '12, Va. '13, '18	Banana: N. C. '12	Arkansas: Tenn.
	Ben Davis: Va. '19	Baldwin: Va. '19
		Black Twig: Va. '13, '18, '19
Early Harvest: Tenn.		Buckingham: N.C. '12.

Susceptible	Moderate	Resistant
Fallawater: N.C. '12, Pa. '11	Fallawater: Va. '19	Delicious: Va. '18, '19
Gravenstein: Va. '19	Gano: Va. '19	
Grimes Golden: S.C. '10		Grimes Golden: Va. '13, '19
		Hibernal: Minn.
Jonathan: Colo. Mo. '15, '17, '18 Ohio '17, Pa. '11 Va. '13, '19	Jonathan: N. Y. '17	King David: Va. '19
	Limbertwig: Va. '19	Maiden Blush: Colo.
King: N. Y. '17	Lowry: Va. '19	Northwestern Greening: Va. '13, W.Va. '17
Lowell: Ohio '17		Okabena: Minn.
Missouri Pippin: Va. '19		Oldenburg: Minn.
Northern Spy: Va. '09	Northern Spy: Va. '19	
Oldenburg (Duchess): Va. '19		
Paradise Sweet: Va. '09		
Pound: Pa. '11		
Rambo: Pa. '11, '17		
Red June: S. C. '10	Red June: N.C. '12	Red June: Va. '19
Rome: Ind. '16 Mo. '15, '17, '18 N.Y. '17, N.C. '12		Stayman Winesap: N.C. '12 Pa. '11, '17 Va. '13, '18, '19
Shockley: N.C. '12, S.C. '10, Va. '19		
Virginia Beauty: Va. '19		
Wagner: Pa. '11		Winesap: Colo. N.C. '12, Ohio '17 Va. '13, '18, '19 W.Va. '17
Wealthy: Iowa '18, N.J. '18 N.Y. '17, '18, Ohio '17 Minn. S.D. '05, '17 W.Va. '15, Wis. '18		Yellow Transparent: Pa. '17 (entirely free)
Willow: Va. '19		
York Imperial: N.Y. '13 Pa. '11, '17, '19 Va. '09, '13, '18, '19 W.Va. '17		

Varieties reported affected - resistance not given.

Bellflower.....N. Y., '19		Wealthy.....Conn., '18	
Hubbardston.....N. Y., '18		Banana.....N. Y., '18	
Opalescent.....N. Y., '18		York Imperial...N. Y., '18	
Twenty Ounce.....N. Y., '18			

The universally accepted control of apple rust is the eradication of the alternate host in the vicinity of orchards. Eradication of all cedars within one mile has generally given good results, but recent experience with the disease in Virginia and West Virginia under most favorable conditions for its development, indicate that safety demands a cedar-free zone of a somewhat larger extent. Regarding this subject M. B. Waite, Office of Fruit Disease Investigations, has furnished the following paragraphs:

"While the Department of Agriculture has been advising the cutting of red cedars for years, in fact since 1888, long before the disease became generally serious and while the experiment stations in these and other states have been urging the eradication of the red cedars, in only certain communities and around certain orchards has this been thoroughly done. The distance necessary for success in eradicating the cedars may be regarded as somewhat of an open question. The experience of the last season in Virginia in this unusual outbreak rather plainly shows that the distance of one mile is not fully effective, where large numbers of cedar trees are involved.

"The first attempts to eradicate the cedars in Virginia and West Virginia, which was quite successful, indicated that one mile, or frequently one-half mile, was sufficient. It is certainly true that the most important cedars to cut are the infected trees nearest to the apples, but it also appears that large numbers of infected cedars even one mile away are dangerous. The Virginia State Law is drawn to enforce cedar eradication for a distance of one mile. A distance of two miles has been suggested as probably effective, but since the difficulties increased and the matter was not well settled at that time, the Virginia growers accepted one mile as probably satisfactory, and we were inclined to agree with them. It appears now that the large commercial orchards are quite likely to suffer unless these dangerous cedars are removed for more than one mile.

"This is interesting from another standpoint which has been considered; namely, that the cedars to be dangerous must in turn be infected from the apple orchards. Undoubtedly, however, small orchards or a few non-commercial trees in home orchards at a closer distance than the main blocks may serve for reinfecting the cedars."

In reply to a questionnaire concerning the progress of cedar eradication collaborators reported as follows:

Virginia: "Cedar cutting clubs are being formed (several counties) and a concerted effort for county-wide eradication of cedars will be put forth this winter. The State Horticultural Society is asking the Legislature to amend the Cedar Rust Law, making it mandatory, and to extend limits of cedars to two miles from apple orchards. Effectiveness of thorough cedar removal was shown by survey of 150 orchards in Augusta county. Severity of disease varied with location, number, size, and exposure of cedars. Orchards in one locality where thorough eradication had been accomplished were practically free from rust and produced good crops of apples." (Fromme)

West Virginia: "We have secured cedar free areas of considerable extent around all the more important commercial orchards in the eastern part of the state. The amount of cedar destruction has really been tremendous and I feel that we have accomplished results of inestimable value. It is a result of cooperation between orchard men, the county as a whole, the Commissioner of Agriculture and the department of plant pathology. I believe that we have saved the growers in the eastern part of the state millions of dollars." (Giddings) Also reported having planted a large orchard in a tract where cedar rust will continue to be abundant, for testing resistance of varieties.

Tennessee: "No move as yet to eradicate cedars. Few cedars in the Cumberland, where fruit growing could be carried on successfully." (Essary) Essary has also stated that in Central Tennessee the red cedar is itself grown commercially, which of course precludes an apple industry of less importance than the cedar.

Arkansas: "The State Plant Board has declared cedar trees a public nuisance in the better apple growing sections, and expects to completely eradicate them in those sections within a year. Public sentiment is back of the movement." (Elliott).

Ohio: "Cedar trees very abundant in southern half of state. The disease is worst in this area where apple orchards are extensive. Progress of eradication is at a standstill." (Selby)

Minnesota: "Cedars are abundant in many parts of the state. Rust is most serious in southeastern portion. Many farms have ceased raising apples in this region, due particularly to rust and scab." (Bisby) (No eradication reported).

Michigan: No rust losses yet reported. Cedars scarce. Cedars and apples grow in proximity in some places without trouble. Believe the organism restricted in distribution.

Colorado: The cedar rust situation in Colorado is not serious. No eradications have been undertaken.

Pennsylvania: "Cedar rust most prevalent in southeast section of Pennsylvania, especially Cumberland Valley. No eradication campaign yet initiated. Under consideration by Sanders and McCubbin." (C. R. Orton)

A detailed survey of the cedar rust situation was made in Augusta County, Virginia by Marshall and Fromme and reported by them in Ext. Div. Va. A. & M. Col. and Polytech. Inst. Bul. 39 : 1-8, 1920. The following data taken from their tabulations show strikingly the relation of the proximity of cedars to losses of the apple crop from rust.

Table 28. Condensed summary: Relation of cedar rust infection of apple to (1) number and proximity of cedar trees, (2) average yeild in barrels per tree, (3) grades, and (4) returns.

Relative number of cedars within 1 mile	Number orchards	No. York Imperial trees	Av. yield per tree in bbl.	Relation to grades No.1's	No.2's	Culls	Value per tree	Return per acre
Very few	4	3,200	2.66	67.2%	7.5%	25.3%	11.57	$497.51
Few	13	12,340	1.53	47.9%	24.7%	27.4%	6.29	270.47
Many	13	12,330	.94	23.3%	32.5%	44.2%	3.27	140.61
Very many	9	9,115	.52	1.7%	6.3%	92.0%	1.11	72.15

Spraying has been frequently reported of value. Giddings (W. Va.) reported it "successful" in 1912, 1913, and 1914. In 1915 he found it "ineffective". Selby (Ohio) in 1919 reported: "Same spray as for blotch good." The extended period over which infection is possible, the rapid growth of leaves during this period, producing new surfaces continuously, and the frequent difficulty of applying fungicides owing to the weather conditions which favor infection, help to make this method of control often impracticable.

Black rot caused by Physalospora cydoniae Arnaud (Sphaeropsis malorum (Berk.) Pk.)

Black rot was reported by collaborators in 1919 from practically all apple growing regions in the eastern half of the United States, and also from Colorado and New Mexico. Greatest loss from this disease occurred in the states which lie east of the Mississippi and south of the Ohio and Potomac Rivers. Georgia reported 10% loss, North Carolina 8%, Tennessee 5%, West Virginia 5%, and Virginia 3%. North of the Ohio River, Illinois estimated losses at 0.2%, Indiana 1%, Ohio 2%, and Pennsylvania 3-4%. New York reported the disease general but only locally severe, particularly in Monroe and Wayne Counties. New Jersey, Delaware, and Maryland suffered unusual losses. In New England it was reported as scarce, in New Hampshire mostly affecting small summer varieties, and was the cause of large losses in Vermont, Massachusetts, and Connecticut.

West of the Mississippi black rot was distributed generally over the non-irrigated apple districts, and was reported also common in Colorado and New Mexico. Its prevalence in the Northwest and on the Pacific Coast was not reported. Arkansas reported much less severe than last year, causing 0.5% loss. In Missouri it was common, causing more damage than bitter rot. Oklahoma reported it causing one-half as much damage as apple blotch, and next to blotch in importance in that state. Texas reported 1% loss. Cankers were abundant in Colorado. In New Mexico black rot caused 90% loss in some neglected orchards, particularly old trees suffering from want of irrigation and pruning, but it was generally slight in well cared for orchards.

Leaf injury was mentioned as being particularly severe in Massachusetts, Delaware, Maryland, West Virginia, Virginia, (Fromme stated: "Frog eye spot found this year in practically every orchard visited, somewhat less in the Shenandoah Valley than in other sections. It appeared unusually early. In many orchards 50-60% defoliation had resulted by July 15.), Mississippi, Illinois, Iowa (leaves of all varieties), Kansas, and Arkansas (foliage infection very general).

Fruit infection was especially mentioned in Pennsylvania (blossom end rot common, especially on Ben Davis), West Virginia, Illinois (blossom end rot common), Michigan (black rot of fruit on trees unusually common), and New Jersey (most common orchard rot in state).

Cankers were reported serious in Mississippi and Colorado.

Losses caused by black rot to apples in transit in 1919 were reported by Bureau of Markets inspectors as given in Table 29.

First reports of black rot in 1919 were received as follows:

April 21 - Virginia	June 9 - New Hampshire
May 15 - Tennessee	June 10 - Arkansas (1st rotted fruit, Red Astrachan)
May 20 - Missouri	
May 25 - Pennsylvania	June 11 - Iowa
May 28 - Indiana	June 23 - Minnesota (leaf)
June 6 - Connecticut	July 10 - Illinois

The Paragon variety (Mammoth Black Twig) was mentioned as particularly susceptible in Virginia.

Table 29. Losses from black rot as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with infection	Average percentage of infection	Range of percentage of infection	Remarks as to seriousness of decay.
Arkansas	13	11	2-28%	Most decay occurs in spots.
California	1	6	6%	Slight decay.
Colorado	4	10	2-25%	Mostly slight decay; blue mold rot noted in some cars.
Illinois	9	42	3 cars-80-95%	Very heavy decay. Other decays noted.
			4 cars-2-18%	Mostly slight decay.
			2 cars-35-40%	Heavy decay, other decays present.
Kansas	1	2	2%	Slight decay.
Maine	1	30	10-50%	Some complete decay; blue mold rot also present.
Maryland	6	8	2-13%	Mostly slight decay
Massachusetts	2	4	2-6%	Slight decay.
Michigan	10	7	2-18%	Some complete decay, mostly slight.
Minnesota	1	3	2-4%	Slight decay.
Missouri	7	9	3-25%	Mostly slight decay.
New York	1	3	3%	Slight decay accompanied by blue mold rot.
Ohio	2	10	3-17%	Slight decay accompanied by other decays.
Oregon	1	11	11%	
Pennsylvania	2	9	3-15%	Slight decay, accompanied by blue mold in one car.
Texas	1	2	2%	Slight decay.
Virginia	36	11	4 cars-25-50%	Heavy decay.
			32 cars-2-24%	Some complete decay, but mostly slight.
Washington	5	11	2-20%	Other decays also present.
West Virginia	13	11	2-39%	Other decays also present.
Unknown	3	12	2-30%	Decay usually in spots.
Total	119		Total number of cars inspected - 2973.	

Control of black rot was reported as follows by collaborators in 1919:

Ohio: (Selby) Pruning and copper spray in July effective.

West Virginia: (Giddings) Spray more effective than dust.

Virginia: (Fromme) "Lime-sulphur 2-3 weeks after codling moth spray gives satisfactory control. The effect of fertilization was evident in one orchard. A strip having nitrate of soda, 3 to 4 lbs. per tree, was almost free from injury, while other portions had a great deal."

Fire blight caused by Bacillus amylovorous (Burr.) Trevisan

Fire blight occurred in 1919 in practically all states where the apple and pear are grown, but for the most part is perhaps the lightest infection of recent years. The group of states lying south of the Ohio and east of the Mississippi, excepting Virginia and West Virginia, constitutes the only area reporting very severe losses to the apple crop from the disease in 1919. Losses in this area ran about as follows: North Carolina, 10%; South Carolina, 10%; Georgia, 12%; Alabama, 5%; Mississippi, 5%; Tennessee, 5%; Kentucky, 2%. Other states in the eastern half of the country estimated losses as follows: Texas, 2%; Arkansas, Missouri, Kansas, Minnesota, Wisconsin, New Jersey, Pennsylvania, and West Virginia, 1%; in Virginia, Delaware, Maryland, Ohio, and Indiana losses were about 0.5%; New England; New York, Michigan, Illinois, Iowa, North Dakota, Nebraska, and Oklahoma report only a trace of injury from fire blight in 1919. While common on pear, it was reported as rare on apple in Michigan.

Of the western states (west of the 100th meridian), Idaho and Oregon reported losses of 1% in 1919; Colorado stated, "disease very prevalent, usual amount of damage", but gave no estimate of loss; Washington, Montana, and New Mexico reported a trace; and Arizona reported that annually 1/2% of the acreage is lost from this disease. California did not report.

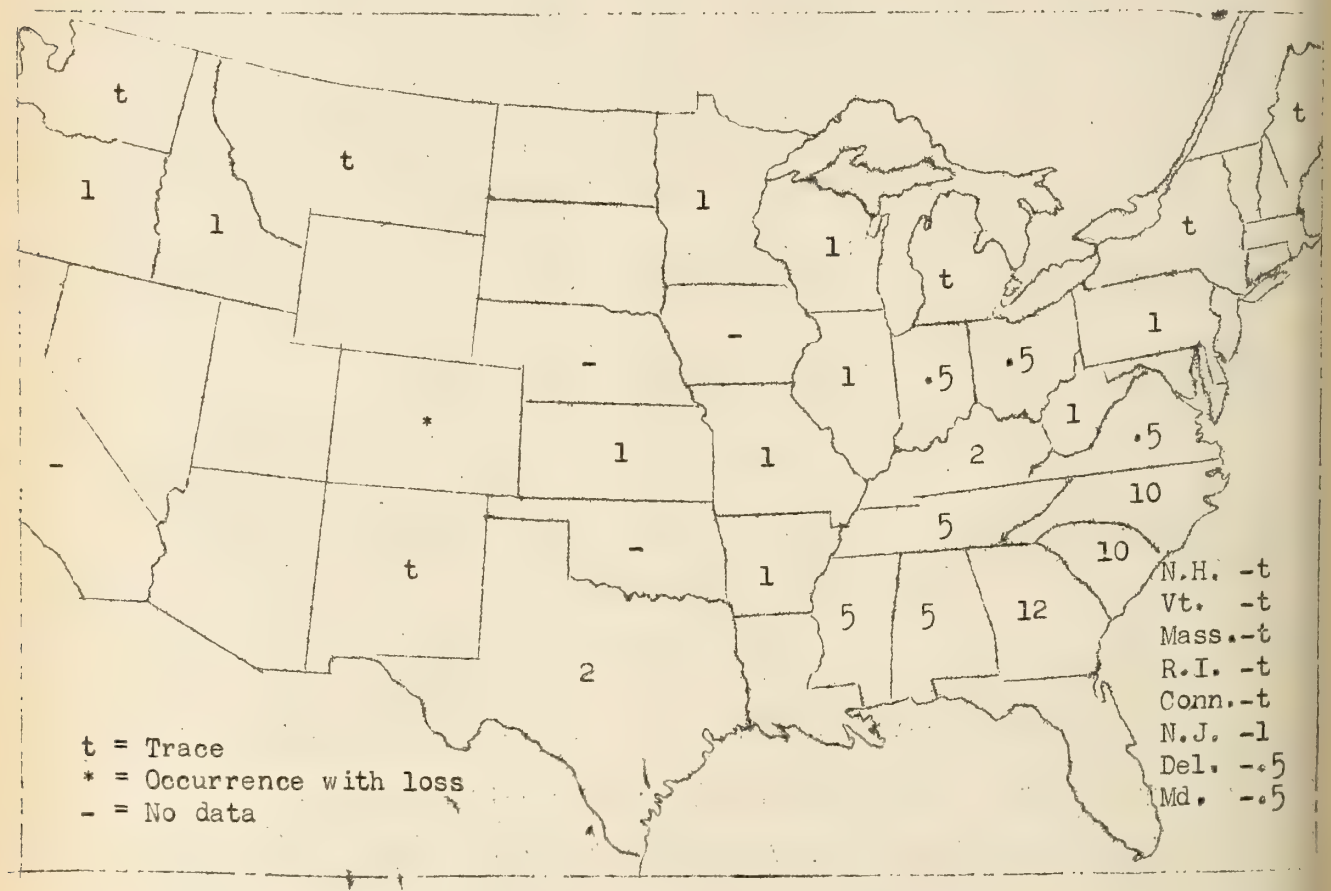

Fig. 26. Occurrence of fire blight (collar blight form generally not included) on apple in 1919.

These losses are understood to result largely from twig and blossom blight. Certain large losses from destruction of trees by collar blight would be very hard to estimate and are not included. Based upon production figures published by the Bureau of Crop Estimates and the percentages given above, losses to the 1919 apple crop of the United States from fire blight were probably over one million bushels, or, roughly, at least 0.7%. About one-half of this loss occurred in the southeastern states from Texas to North Carolina; about one-fourth of it New Jersey, Pennsylvania, West Virginia, Missouri, Arkansas, Kansas, Wisconsin, Minnesota, Idaho, and Oregon, and approximately one-fourth of it in Virginia, Delaware, Maryland, Ohio, and Indiana.

M. B. Waite, United States Department of Agriculture, comments as follows upon the occurrence of blight on pear and apples:

> "Pear blight was much less abundant over most of the eastern United States than it has been for several years past. The great outbreak of 1914 has been greatly diminishing, until this year in general there has been less pear blight in humid eastern United States than probably at any time previous to 1912. The last outbreak previous to 1912 in the Appalachian Fruit Belt and adjacent Piedmont Coastal Plain occurred about 1900-1902. York Imperial apple trees were badly blighted in the tops at that time and blossom blight was abundant on a great variety of apples, including the Winesap and Stayman Winesap, York Imperial, and even the Ben Davis among winter varieties, and especially the Transparent, Fourth of July, Red Astrachan, Early Harvest, Red June, and others among summer varieties. From 1900 to 1902, at least during certain of those years, the blossom blight and twig blight of the apple was so abundant that in traveling through parts of Maryland and Pennsylvania, the brown scorched tree-tips were plainly visible from the train.
>
> "Referring again to the 1914 outbreak, this began to be serious in 1912. It increased during 1913 and reached its climax during 1914. From that year on, it has gradually receded until during the present season it may be regarded as distinctly sub-normal."

The collar blight form of fire blight in the apple is reported upon by several states in 1919. Manns and LeCato (Delaware) reported considerable "collar rot" in apple orchards in Kent County and stated:

> This rot is due to 2 to 3 years of very severe fire blight, 1913-1917 inclusive being years when the disease was quite severe. The troubles seem to gain entrance to the collar through lesions caused by winter injury on the south and southwestern side of the tree trunks. At the time of ascension of sap these cracked areas in the lesions permit insects to visit the oozing trees carrying bacterial infection to the trunk. The organism then goes up and down infesting the roots under the ground and completely killing all the cambium around the roots."

Arkansas (Elliott) reported, "Loss of some Transparent trees every year from collar blight." Idaho (Hungerford) reported, "What appears to have been a very severe attack of collar blight and root rot about 5 years ago has killed a large percentage of trees in the Boise Valley and adjacent regions. Reports are rather hard to follow, but it appears to have been blight."

Concerning "collar rot" Hungerford stated further:

> "This trouble is very common in Southern Idaho and has recently been reported from Post Falls, between Spokane and Coeur de 'Alene. It is especially severe upon Wagener and Jonathan, The Rome and Delicious seem to be fairly resistant. It is our opinion that the condition is brought about by winter injury, followed by fire blight in some cases."

The collar disease situation in the apple districts of Idaho was called to the attention of the Office of Fruit Disease Investigations, United States Department of Agriculture, in 1916. The organism of pear blight was isolated from the infected collar of a tree specimen sent in, and in June, 1917, the writer (Hutchins) made an investigation in the field, in which a large number of orchards from Boise to Weiser and several at Lewiston were visited. At the time these collar cases were observed collar blight (B. amyloverus) was found to be taking a heavy toll of trees, and evidently the direct cause of the majority of collar-diseased trees. This great epidemic followed closely a severe outbreak of top blight, in which eradication had been neglected. Blighted twigs, limbs, and bodies were generally present, and collar cases were, when fresh, frequently traceable to infected shoots and suckers through which the organism had gained entrance to the root, collar, or body. This district was again visited by the writer (Hutchins) in November, 1919, and while both collar and top blight were still present, the severity was scarcely a circumstance to the situation in 1917. The organism was at this time again isolated from the collars of Grimes and Jonathan trees and kept in pure culture until April (1920), when it was inoculated into the blossoms of Keiffer pear at the Department Experimental Farm, Arlington, Virginia, and produced typical blossom blight (B. amyloverus).

Several investigators have observed collar blight to be one of the important collar diseases in central irrigated districts of Washington.

Referring to collar blight (B. amyloverus), M. B. Waite, United States Department of Agriculture, makes the following statement:

> "This form of the disease (see pear) was found in considerable abundance on the apple at Montrose and Delta, Colorado, in 1904. It was later, in 1907, found in Utah in moderate abundance. It occurred occasionally along with the similar form on the pear in the Sacramento Valley of California in 1905-06 and '07. In 1906 numerous cases were found on Sptizenburg apples at Payette, Idaho. It was looked for but not found at Hood River, Oregon. In the summer of 1907, it was found abundant in the orchards of D. M. Wertz, at Quincy, Pa., and during this and subsequent years, was found abundant on Grimes in the Shenandoah Valley of Virginia and West Virginia."

The following varieties in 1919 were reported as most susceptible to blight:

Crab-apples	- Iowa, Minn., Wis.	Esopus	- Idaho, Oregon
Grimes	- Arkansas.	Transparent	- Ark., Ill.
Jonathan	- Ala., Ark., Ida., Ill.	Wealthy	- Wisconsin
Okabena	- Minnesota	Banana	- Indiana
Yellow Newtown	- Virginia		

It was reported as severely attacking the wild hawthorne in Wisconsin.

Powdery mildew caused by Podosphaera leucotricha (E. & E.) Salm.

Apple powdery mildew occurs from coast to coast and from the northern to the southern boundaries of the apple belt.

East of the Rocky Mountains this disease is most often reported serious in nurseries and occasionally on young orchard trees. It seldom causes much loss in bearing orchards, is considered controllable, and is, in general, not of great importance to the eastern apple industry as a whole. Losses over this area were slight in 1919. West Virginia reported a large number of trees injured, with slight loss; New York, Pennsylvania (on Gravenstein), and Ohio reported scattered local occurrence. It appeared locally also in South Carolina, with no loss, and was observed on nursery stock in Mississippi.

In certain Pacific Coast districts powdery mildew has long been a serious disease of the apple, not only affecting young trees in orchards and nurseries, but severely attacking bearing orchards, reducing the vitality of the trees, influencing the setting of fruit, and causing great loss from reduction in market grades owing to mildew markings on the fruit.

Oregon reported the disease abundant, especially in young unsprayed orchards. Idaho reported injury slight, but the disease common in neglected orchards. Washington stated that it is common in Western Washington and in central irrigated regions. For occurrence in California see below.

The following statement by D. F. Fisher, Office of Fruit Disease Investigations, United States Department of Agriculture, summarizes the importance of this disease in the interior apple growing districts of the Pacific northwest:

> "Powdery mildew is very prevalent and spreading in the interior irrigated districts of Washington, especially in the important producing sections at Wenatchee, Yakima, and Walla Walla. It is not serious in the Spokane district nor the Hood River Valley, Oregon where apple scab is prevalent and controlled by spraying.
>
> "Losses due to powdery mildew are difficult to measure on account of the character of the principal injury - a reduction in the vitality of the tree which results in crop reduction. Some badly affected orchards have failed to bear a crop for the last three years, and wherever infection is severe there is some loss for fruit buds fail to 'set' on infected twigs. Besides crop reduction, powdery mildew russets the growing apple and thereby excludes it from the extra fancy grade. In many localities fully 40% of the crop was so affected in 1919, and this loss can be assessed at about 25¢ to 30¢ a box."

P. S. Darlington, District Horticultural Inspector at Wenatchee, Washington, gives the following estimates of losses (Feb. 26, 1920):

"The principal sources of loss affecting the fruit itself, so far as plant diseases and physiological troubles are concerned, are apple mildew and bitter pit or baldwin speck. There are, of course, some other losses of less consequence from such troubles as drought spot and stigmonose. Apple mildew is pretty widely scattered but is causing serious loss only in a few rather limited areas and I would scarcely know how to begin to estimate this loss. I believe loss from bitter pit is becoming less serious every year as the trees get older, but it still causes a considerable loss. I would say just as a rough guess that an estimate of from $150,000 to $200,000 loss from these two diseases in this district yearly would be a conservative estimate, and that would not take into consideration the loss caused by the mildew on future crops."

Charles L. Robinson, District Horticultural Inspector, at Yakima, Washington, gives the following figures for 1919 in the Yakima Valley:

"I should judge that perhaps 10% of the fruit (apples) was lowered in grade on account of mildew markings. In addition to this there are many orchards in the Valley that are seriously injured as to fruit spur development and the general vigor of the trees. It is almost impossible to make an accurate estimate of the extent of that damage, but I should judge that it cut down the crop to the extent of at least several hundred cars."

W. S. Ballard, Office of Fruit Disease Investigations, United States Department of Agriculture, furnished the following statement concerning powdery mildew in California:

"Apple powdery mildew is found in all the larger apple growing districts of California, including the Pajaro Valley, the Sebastopol district and Yucaipi district. It is impossible to measure the actual damage done by this disease, since in this state the infections occur practically entirely on the foliage and twigs, in contrast to the Northwest where the fruit also is often involved. There is, therefore, no direct crop loss due to powdery mildew attacking the fruit. In unsprayed orchards a large percentage of the leaves are usually infected and the severity of the infection may vary from a single small spot on the under side of the leaf to a complete covering of both the upper and lower surfaces. Even a small infection causes deformation and stunting of the growth of the leaf. To measure the damage done to the tree as a whole, and to its crop producing ability would involve first a quantitative determination of the loss in photosynthetic and other physiological activities occasioned by the powdery mildew, and this, for a number of reasons, would be very difficult to determine, so that the best that we can do is make a general comparison of the annual twig growth and of the abundance, size, and 'quality' of the foliage of badly diseased and comparatively healthy trees. Such a comparison is markedly in favor of the more healthy tree, even though our present methods of control are not sufficient to enable us

to keep the tree entirely free from mildew. From a practical standpoint, with our present knowledge of methods and available fungicides, it is impossible to obtain complete control of apple powdery mildew on susceptible varieties in districts where climatic conditions favor its development. The result is that the grower spends such an amount of money on spraying, etc., as he considers justifiable, and thereby keeps his trees in as healthy condition as he feels is justified by the net returns."

In the light of these estimates it is interesting to contemplate the unique history of powdery mildew as affecting the apple industry of the United States. Widely and for years distributed over the older apple regions of the East, which until very recently have produced practically the entire commercial crop of the country, powdery mildew has seldom, if ever, been serious in bearing orchards.

Now with the enormous development of the apple industry in the irrigated valleys of the West, Washington in particular, where the sprays which are needed to control common foliage and fruit fungi of the humid regions are omitted, this disease has assumed an important role in bearing orchards. According to statistics published by the Bureau of Crop Estimates, Washington produced in 1918, 17.3% of the total commercial apple crop of the country. In 1919, a light year in general for the East, Washington produced 24.6% of the total commercial apple crop, or more than the combined commercial production of New York, Virginia, and Missouri for this year.

It will, therefore, be seen that the ravages of powdery mildew in an important state like Washington become at once a serious problem to the commercial apple industry.

The following statement regarding varietal susceptibility and control has kindly been furnished by D. F. Fisher (United States Department of Agriculture):

"The most susceptible varieties are Jonathan, Esopus (Spitzenberg), Rome, and Gano (black Ben Davis). The most resistant are Winter Pearmain, and Winesap.

"In the irrigated districts the fungus depends upon the prevalence of dews for moisture for spore germination. First appearance of the disease is generally correlated with condition of full bloom, since infected buds that harbor the overwintering mycelium are delayed in opening until about this time.

"Control depends upon efficient use of sulphur sprays at frequent intervals, supplemented by pruning out infected twigs. Efficient sulphur spraying is complicated by the susceptibility of the fruit to sulphur sunburn (see note on this subject), also to the difficulty of protecting the rapidly growing tips and under surfaces of the leaves, which are the most susceptible parts. Growers are also handicapped by lack of experience in this type of spraying, since they have never had to combat any other fungous disease and the technique of spraying differs from that required for insect control."

Heald stated that in the Yakima Valley a considerable amount of Sherwin Williams dry lime-sulphur has been used.

Fruit spot caused by Phoma pomi Passer.

Fruit spot was particularly serious in Arkansas in 1919, where the commercial apple crop is estimated to have suffered a loss of 15-25% from this disease. Elliott stated that it probably caused a loss of over $200,000 on Jonathans alone.

West Virginia (Giddings) reported 10% injury with 3% loss and mentioned that the disease was abundant and unusually general.

Pennsylvania, New Jersey, and Connecticut reported occasional occurrence with slight loss.

Illinois (Anderson) reported: "Phoma pomi rare, very slight damage. This is the first report of this disease in the state. Specimens of Grimes sent from Calhoun County were seriously infected. It is probable that it occurs in other parts of the state."

Presence of Phoma pomi on commercial shipments of apples in 1919 is reported as follows by the Bureau of Markets inspectors:

Table 30. Losses as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with infection	Average percentage of infection	Range of percentage of infection	Remarks as to seriousness of infection
Arkansas	2	66	66	Severe infection.
Maine	1	4	3-5	Slightly spotted.
Maryland	1	40	40	Bad spotting.
New Hampshire	1	22	20-25	Estimate includes sooty blotch.
Pennsylvania	1	33	33	Bad spotting.
Virginia	2	33	17-50	Severe infection in one car.
West Virginia	2	100	100	Very bad spotting.
Total	10		Total number of cars inspected - 2973	

Jonathan, Grimes, and King David are the varieties which were most seriously affected in Arkansas and also considerable was reported on Ben Davis in that state. Jonathans were severely attacked in one locality in Pennsylvania.

Referring to control of this disease in Arkansas, John W. Roberts (United States Department of Agriculture) stated:

> "In well sprayed orchards the disease was almost perfectly controlled. Adequate control was not had by means of dusting. In our own plots, spraying gave almost perfect control, but the dust plots were badly affected. The check plots were 100% diseased."

Sooty blotch and fly speck caused by Leptothyrium pomi (Mont. & Fr.) Sacc. and Phyllachora pomigena (Schw.) Sacc.

The relative prevalence of sooty blotch in the apple producing regions of the United States, as reported by collaborators during the period of 1903 to 1919, suggests the following arrangement of the states in groups according to severity of the disease.

Table 31. Relative prevalence of sooty blotch on apple in the United States.

Groups	Relative prevalence.		Results of market inspection, 1919.	
	Average	1919	No. cars with sooty blotch	Average % fruits affected
I. (a) Pa., Md., Ohio, Va., Ind., W. Va. Ill., Ky. Mo., N. C.	Severe - Region of heaviest and most frequent losses	More: Pa., O., Ky. Average: W. Va., Va., Mo. Less: Ind., Ill.	17	36
(b) Mass., Ark. Conn., Nebr. R. I., N. J., Del.	Common, troublesome, sometimes severe, especially in Conn.	More: Conn. Average: N. J., Del.	3	24
(c) Tenn., Ga., S. C., Ala., Miss.	Mostly abundant: no definite data.			
II. (a) Maine, Mich., Mont., N. H., Wis., Idaho Vt., Minn., Wash., N. Y.	Slight to rare.	More: Minn.	3	13
(b) Iowa, Okla., Kans., Texas	Slight to rare.	More: Kansas.	NOTE: 2,973 cars of apples were inspected in 1919, and of this number 23 were found affected with sooty blotch, as listed above.	
III. (a) Ore., Wyo. Calif., Nev., N. Mex., Colo.	None.			

Sooty blotch is widely distributed over the eastern half of the United States, or east of the 100th meridian, the Dakotas, Louisiana, and Florida being the only states which have not reported it, and, of course, apple production is inconsequential in North Dakota, Louisiana, and Florida, while South Dakota produced in 1919 only 302,000 bushels total and 3,000 barrels commercial crop. West of this line the disease is only reported from Montana, Idaho, and Washington, but no reports were received from any western states in 1919.

In all of the northern tier states from Maine to Washington, except North Dakota, sooty blotch is reported of small importance and generally slight to rare. This is evidenced by extracts from reports of these states as follows: Minnesota, the only state of this group to report on sooty blotch in 1919, stated "Disease reported from Hennepin and Wabasha Counties this year, infections moderately severe in both cases. Sooty blotch is not common in Minnesota, the first authentic report was from Blue Earth County in 1918". (Bisby) Montana reported sooty blotch to occur in that state in 1918, but gave no further data. Idaho (C. E. Temple) reported it "Prevalent, small injury" in the northern part of the state in 1913. Washington (W. A. Lawrence), 1907, reported fly speck from Jefferson, Pierce, and Whitman Counties. In 1908 Lawrence reported "Fly speck, Leptothyrium pomi, rare, only observed twice this year on a few apples collected late in the fall, Puyallup, Wash." Heald and George reported "Fly speck, Leptothyrium pomi," from Mason County in 1916.

The disease is apparently slight to rare also in Iowa, Kansas, Oklahoma, and Texas. In 1919 Kansas reported "Sooty blotch probably aided by wet season, very unusual for it to occur in Kansas." Oklahoma, 1919: "Few reports, not of much consequence."

Massachusetts, Connecticut, Rhode Island, New Jersey, and Delaware generally reported sooty blotch common and troublesome, often causing serious depreciation in market values of fruit, particularly from unsprayed orchards. For example, in 1906 and again in 1916 Connecticut reported concerning sooty blotch: "One of the worst apple diseases". Delaware averages about 1/2% of injury. In 1919 this group reported as follows: Connecticut - more than usual; New Jersey-common in neglected orchards; Delaware - as usual 1/2% to 1% of crop injured.

Farther west, sooty blotch is troublesome in Nebraska and Arkansas. In 1907 Nebraska reported "Leptothyrium pomi is present in the majority of orchards in eastern Nebraska". Since, it has frequently been reported as widespread, but estimates of losses are not given.

Reports indicate that heaviest and most frequent losses from sooty blotch occur in Pennsylvania, Ohio, Indiana, Illinois, Missouri, Virginia, West Virginia, Kentucky, and North Carolina. In 1910 Pennsylvania reported 10% injury, 1/2% loss; 1911 - 15% injury, 2% loss; 1914 - 10% injury, 5% loss; in 1917 - 8% depreciation in market value of fruit due to sooty blotch. In 1905 Ohio reported 20% injury, in 1909 - 50% injury in 14 counties with $100,000 loss. Indiana: 1908 - 25-30% injury in 4 counties; 1910 - 18-22% in several counties; 1911 - 5-8%; 1914-15 very common, 1916-17 less. Illinois: 1911, sooty blotch widespread, especiallly in southern part of state, large amount of injury in many orchards, 1912 less. Missouri: 1905 - 75-100% of crop injured in localities, about same until 1910 when Rolfs reported 50% to 80%of crop injured in several southern counties. The disease is abundant in Virginia, West Virginia, Kentucky, and North Carolina. It is also common and abundant in the other southern states east of the Mississippi, but reports of its relative prevalence are incomplete.

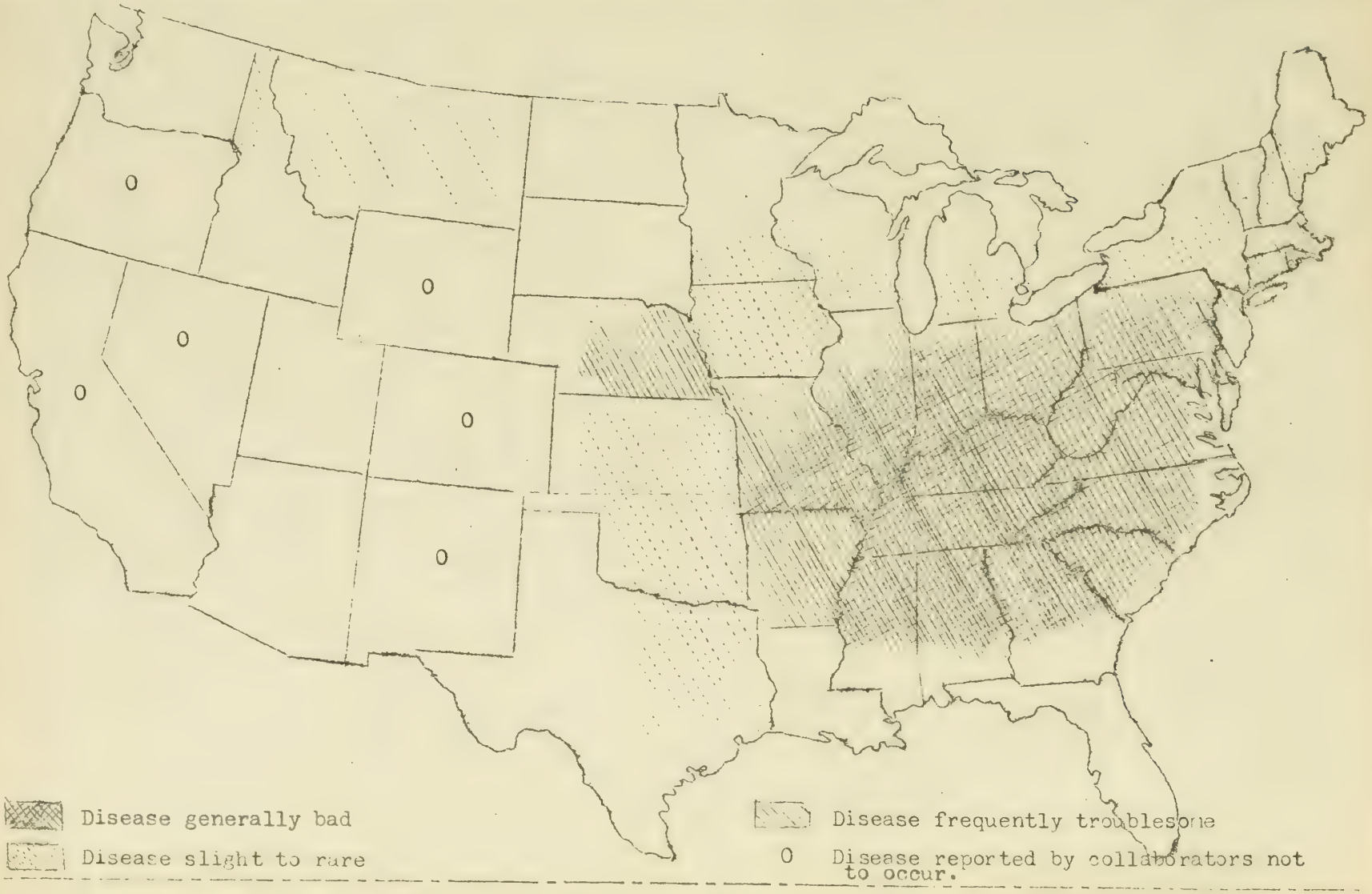

Fig. 27. Occurrence of sooty blotch in the United States, according to reports of collaborators.

In 1919 the above states reported sooty blotch as follows: Pennsylvania: More than in 1918, severe on York Imperial, 10-15% injury, 2-3% depreciation. West Virginia: Abundant 20% injury, slight loss, Bordeaux spray most effective. Ohio: More than usual, favored by late rains, midsummer copper sprays excellent. Kentucky: 100% injury where orchards were not sprayed. Indiana: No loss. Illinois: Rare. Missouri: Common, much injury.

Control in 1919

West Virginia: Bordeaux sprays most effective.
Ohio: Midsummer copper sprays excellent.

Blister canker caused by Nummularia discreta Tul.

This disease in 1919 caused, as usual, much damage in certain central states. Nebraska (Wilcox) stated: "Continues to be our most important disease." Kansas (Melchers) reported: "Reports at hand show that this disease was less common the past season than has been observed for the last five years. Apparently the abundant rain in the spring of 1919 gave the trees a more vigorous growth. It apparently made them less subject to attack. Fewer orchards were suffering from blister canker than usual."

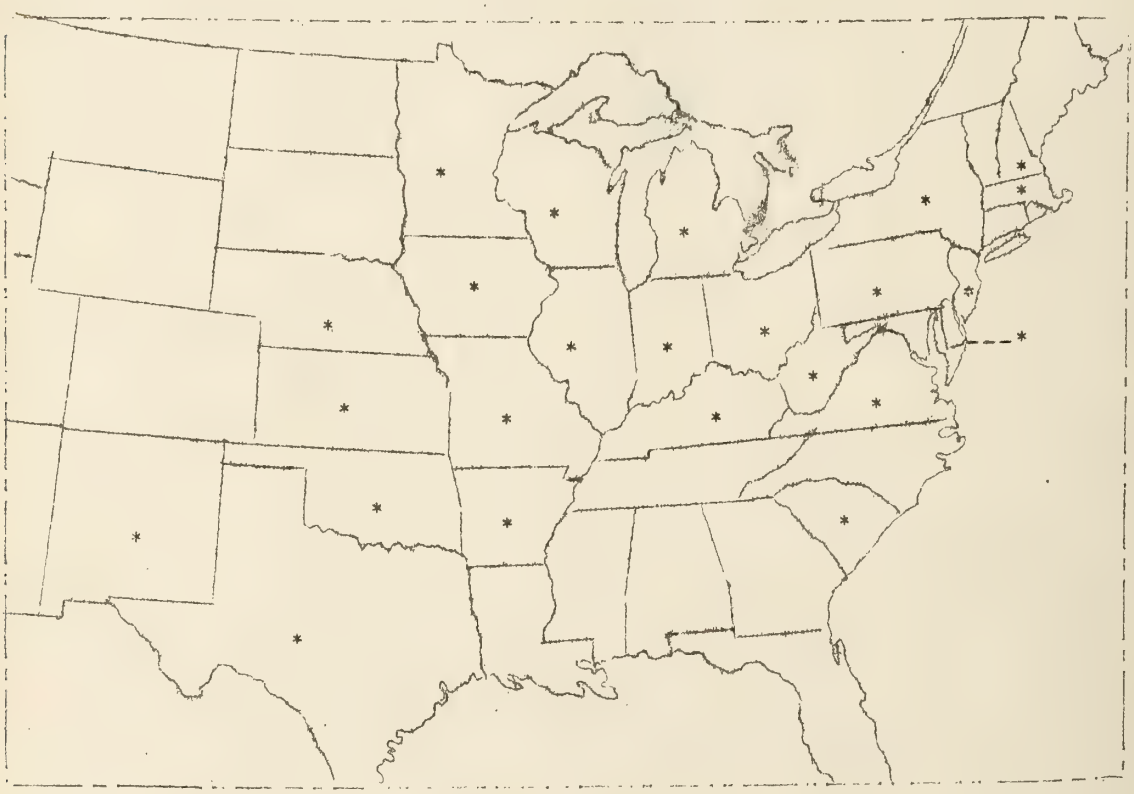

Fig. 28. States in which blister canker has been reported to occur.

Missouri (Maneval) reported the disease as general and severe, killing a good many trees each year. Arkansas (Elliott) estimated the injury to the crop at 5%, or $250,000. In Oklahoma it was reported as only present and not serious.

Blister canker also caused damage in the Ohio Valley. Indiana reported it very destructive locally in 1919. While prevalent in Illinois, injury was estimated at less than .1%. Injury was apparently slight in Ohio, Pennsylvania, New York, and the coastal states from Virginia northward. Bisby stated that the first authentic report of the occurrence of blister canker in Minnesota came from Winona County, April 13, 1919, when two trees were found affected. One other case was located later in the season, May 1, 1919, when a large canker was found on a healthy tree in a 10-acre orchard near St. Paul.

On the preceding map (Figure 28), the states from which collaborators have reported the occurrence of blister canker are marked with a "*".

Varietal susceptibility was reported as follows in 1919:

Most susceptible	Commonly affected
Ben Davis - Arkansas	Grimes - Illinois
" " - Illinois	Willow - Illinois
" " - Indiana	
" " - Pennsylvania	

Prof. Selby (Ohio) recommends control by removing and burning cankers before March 15. In Phytopathology 10 : 58, 1920, W. D. Gloyer published a summary of the occurrence and control of blister canker in New York.

Anthracnose caused by Neofabraea malicorticis (Cord.) Jackson.

A general summary of the history and extent of this disease has already been given (Plant Disease Bulletin, Suppl. 1:9, 1919).

In 1919 reports on the northwestern anthracnose were received only from Washington, although it is known to be present in Idaho, and severe in western Oregon. Greatest damage from the disease is reported to occur west of the Cascade Mountains in Washington and Oregon.

Heald and Dana (Washington) stated: "Neofabraea malicorticis is reported from widely separated points west of the Cascades." Arthur Frank furnished the following, dated July 8:

> "Report of survey of orchards April 10, 18, May 1 and 10, 1919. This was work done in the vicinity of Puyallup and up and down the valley and in nearby districts. The anthracnose (Neofabraea malicorticis (Cord.) Jack.) is generally prevalent and quite severe. More of the trouble is present this season than in the last three seasons. The trouble is spreading into many young orchards rapidly and is doing much damage. Most damage is done by the fungus girdling small limbs. In some cases the trunks of small trees are girdled. Many new cankers are present on one year old wood. Cankers were found giving off spores June 11, 1919, and cankers are found giving off spores at present time, July 7, 1919.

"Bellingham, June 28, 1919: Visited orchards at Bellingham, Ferndale, Lynden and at points in the county between, Anthracnose is very severe in this county. Many of the older orchards have had the trouble for as long as 16 years or more. One orchard was seen which was reputed to have had the 'worst case in the Northwest'. The owner had sprayed last season and this spring there were no new cankers to be found. The trouble is more prevalent here than last season.

"Vancouver, June 29, 1919: Some anthracnose present about Vancouver and nearby points but not so abundant as at other points."

Inspectors of the Bureau of Markets found 5% anthracnose in one car of apples from Oregon, and apples in two cars from Washington were found to contain 20-22% anthracnose associated with other decays.

Crown gall caused by Bacterium tumefaciens Sm. & Towns.

Crown gall occurs in probably all apple growing regions of the United States. The fact that the bacterium has been prevalent in nurseries for many years, that it infects a wide range of hosts, and that it will survive under all ordinary conditions endured by the host, accounts for its very wide spread.

It is probably more difficult to estimate losses from crown gall than from any other apple disease. It would be possible to place a fairly accurate valuation upon annual losses in nurseries where cost of production is readily calculated and losses are definitely computed in a single season, but in commercial or home orchards the situation is exceedingly complex. Irregularity of occurrence would make it necessary to canvass each orchard in a given area. Many orchards are injured by this disease without the knowledge of the owner, the enemy remaining hidden beneath the soil, and in other orchards crown gall may be present but producing no apparent ill effects on the trees.

Trees infected when planted often die before they reach the bearing age from crown gall, or from secondary infections gaining entrance from the gall lesions. Frost injuries are known to pick crown gall trees frequently. Crown gall trees are generally stunted and less vigorous than uninfected trees, they will probably bear profitably at a later age and then may be expected to die several years before their normal producing period is completed. Losses to the grower include the factors involved in the cost-production of a bearing orchard and in decreased producing power.

It is, therefore, not surprising that only a few of the states where crown gall is known to occur report their losses for 1919. Most definite statements came this year from the following states: Arkansas reported 10% crop injured; Georgia, common, trace to 50% injury, 10% loss; Alabama, general; Oklahoma reported from three localities. Learn inspected one orchard of 20 acres where the root system of every tree examined was a mass of knots and fine roots. He suspects another orchard of 40 acres to be in the same condition; Missouri reported the disease from one area; Ohio reported chiefly nursery stock affected; New York, severe in one county; New Mexico reported both aerial and crown forms, slight losses; Idaho stated that the disease was not common. It was reported from two areas in Washington.

Brown rot caused by Sclerotinia sp.

For a summary of the occurrence and importance of this disease in the United States, see Plant Disease Bulletin, Supplement 1: 13, 1918. In 1919 it was reported as causing 0.5% to 1% injury to the crop in Delaware. Pennsylvania (Orton) reported it as causing 5-10% loss on Cox Orange at State College, and also on Baldwins. It was more prevalent than usual in the state, but caused very slight loss. Earliest report August 20th. In Indiana it was first reported June 4, but it was only slightly prevalent. South Carolina reported brown rot on storage apples only. Alabama reported it unusually general and severe. In Arkansas is caused a trace of injury, appearing first on Red Astrachan in June. Washington (Heald) stated: "Twig and blossom blight due to Sclerotinia sp. reported from a number of localities by Frank from Island and Whatcom Counties."

Table 32. Losses as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with brown rot	Average percentage of brown rot	Range of percentage of brown rot	Remarks as to seriousness of decay.
Arkansas	5	6	3-12	Estimate includes some blue mold.
California	3	3	2-3	Slight decay.
Delaware	4	13	2-23	Two cars slight decay, two cars all stages of decay.
Idaho	1	9	8-10	Includes some blue mold.
Maine	1	3	2-4	Slight decay.
Maryland	1	27	25-30	
Michigan	1	13	10-15	
New Mexico	1	4	3-5	Slight decay.
New York	2	4	2-6	Slight decay.
Pennsylvania	1	5	5	Slight decay.
Texas	2	4	3-5	Slight decay.
Virginia	4	7	5-10	Mostly slight decay.
Washington	2	8	5-10	Mostly slight decay.
West Virginia	5	9	5-15	Decay mostly in spots.
Total	33		Number of cars inspected - 2973.	

Blue mold rot caused by Penicillium expansum (Lk.) Emend. Thom.

Blue mold rot caused an immense amount of damage in 1919 to apples in transit and storage. The losses in common storage and in local markets are not easily estimated. Of carlot commercial shipments, the following data were collected by the inspectors of the Bureau of Markets. 2973 cars of apples were inspected at destination by the inspectors in 1919. Of this number, 706, having points of origin in 25 states and Canada (9 cars), were found to be infected with blue mold rot, Penicillium expansum, the rot affecting from 1 to

87% of the apples by cars, and averaging 10.2% of the total fruit in the 706 cars. Computed for the 2973 cars, 2.4% of all the apples inspected in 1919 by Bureau of Markets inspectors were affected with blue mold rot.

Bitter pit (non-parasitic)

"The term bitter pit is used as snyonomous with 'Stippen' and Baldwin spot, the disease being characterized by brown spots and streaks in the region of the vascular, particularly the subepidermal tissue. The weather conditions in the eastern United States were not favorable to bitter pit the past season (1919) but there have been reports of some losses on Rhode Island Greening in sections such as New York state where the crop was light and the fruit, therefore, somewhat forced in its growth." (Charles Brooks, Office of Fruit Disease Investigations, United States Department of Agriculture).

Arkansas (Elliott) reported for 1919: "Probably the worst outbreak of this disease ever known here. It appeared early in August on Grimes and Jonathan. Some Jonathan crops entirely reduced to culls. Other orchards not injured in the least". Virginia (Frome): "Quite severe on King David from Rockingham County." Pennsylvania (Orton): "Baldwins and Spys reported as being generally affected." New Jersey: Very common. Connecticut: Much less than usual, one report only. Ohio (Selby): "Relative prevalence normal, small injury, weather conditions favorable to disease, and early maturing of the fruit." Michigan (Coons): "Complaint that there is an abundance of bitter pit in Oakland County this year." Idaho (Hungerford): "Reported to be common in Twin Falls County, no survey made." New Mexico (Leonian): "Local, Stayman Winesap most susceptible." Washington (Heald & Dana): "Reported from both eastern and western Washington, common in central irrigated regions also." (See also P. S. Darlington's estimate of losses from powdery mildew and bitter pit at Wenatchee, under "Powdery Mildew", page 118).

Of the 2,973 cars of apples inspected by the Bureau of Markets inspectors in 1919, 42 were found to be affected by bitter pit as follows: 5 cars from eastern, 5 from central, and 31 from western states.

Table 33. Losses from bitter pit as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with bitter pit	Average percentage of fruits affected
Delaware	1	5
Virginia	4	4
West Virginia	1	10
Illinois	1	15
Arkansas	4	10
Idaho	1	12
Washington	10	15
Oregon	1	9
California	19	11
Total.....	42	Number of cars inspected - 2,973.

Summary of Varieties Reported Affected in 1919.

Arkansas: Jonathan, Grimes, Ben Davis, Winesap, Delicious.
Virginia: King David.
Pennsylvania: Baldwin, Northern Spy.
New Mexico: Stayman Winesap (most susceptible).

Rosette.

Rosette of the apple is generally rare throughout the eastern half of the United States. In fact the dense tuft of leaves (rosette) terminating a branch or shoot otherwise practically bare, which characterizes this disorder, is so seldom encountered as to be almost a curiosity.

In 1901 Paddock described rosette and called attention to its importance in certain apple regions of Colorado. From 1910 to 1914 it began to be noted widely in Idaho, Oregon, and Washington.

In 1919, in addition to its usual occurrence, rosette was reported for the first time from three or four localities in Kansas by Melchers, attended by no serious injury. In Idaho for this year it was reported: "One of our most common apple diseases."

Few estimates of losses from this disease have been received. Idaho placed injury in 1919 at 5%, and the estimated loss in the state at 3% of the total crop. Slight varietal resistance is claimed.

In a 1904 Colorado report, Paddock stated concerning rosette: "This is a disease which results from an uncongenial soil condition, a poor water supply and winter injury."

Hungerford (Idaho, 1919) remarked: "Clearly associated with soil conditions. Hard pan, slick spots, shallow soil, high water table, all have been associated with the trouble (rosette)."

The following statement concerning rosette in the interior irrigated districts of the Pacific Northwest is furnished by D. F. Fisher and Charles Brooks, Office of Fruit Disease Investigations, United States Department of Agriculture:

> "Rosette is associated with an unbalanced condition of moisture and nutrition. It is most frequently found on very compact soils, on shallow soils underlaid by 'hardpan', or on soils where the humus content has been exhausted by continuous clean cultivation with consequent tendency towards 'baking' or 'puddling' of the soil following irrigation and the formation of a 'cultivation sole' a few inches below the surface which effectively prevents adequate irrigation of the tree.
>
> "Inadequate irrigation of the tree in itself apparently is not the direct cause of rosette, for this trouble in no wise resembles typical drought effects. But an inadequate moisture supply necessarily unbalances the food supply, either permitting excessive concentration of certain injurious salts or depriving the tree of certain necessary elements.
>
> "But whatever the factors involved, it has been demonstrated that with the more general adpotion of alfalfa as a permanent orchard cover crop in the irrigated districts of the Northwest, the

spread of rosette has been arrested. Improvement in rosette conditions is not particularly noticeable until about the 3rd year after alfalfa is established, but after this time it is rapid and by the 5th year the trouble usually disappears entirely. Blasting the soil gives only temporary relief, since it does not remove the causes contributing to the original soil condition. Applications of fertilizers are not effective unless the physical condition of the soil is corrected. Shallow rooted cover crops, such as red clover and vetch are likewise not effective. Pruning out rosetted branches results in accentuating the trouble and it is best to leave affected trees unpruned."

Jonathan spot (probably non-parasitic).

The following states reported Jonathan spot in 1919: Delaware, in storage only; Ohio, relative prevalence less; Michigan, "Occurring in abundance on Jonathan on trees near Farmington, Mich." (Coons, Nov. 1, 1919); Idaho, always common on Jonathan apples picked late and stored; Washington, common in central and eastern districts.

Water-core (non-parasitic).

Water-core is known to occur widely over the apple-producing regions of the country. While reports are not sufficiently complete for a general survey of its behavior, some states have given a fair idea of local occurrence.

Selby reported from Ohio: 1915 - Water-core has developed to an unusual extent, serious in Delicious and King David at Wooster. Results of all investigations show that early picking can be relied upon to reduce or prevent water-core. 1916 - "Prompt picking and low nitrogen". 1917 - "Follows too late picking of varieties." 1919 - More prevalent than usual in that fruit matured early. Fruit should be picked promptly.

Pennsylvania reported: 1915 - Slight loss, 2% injury. 1917 - 3% injury in three counties. 1918 - York Imperial affected in certain orchards, watery part confined chiefly to flesh, "glassiness". 1919 - Some at State College on Wolf River.

New Jersey: 1918 - Occasional. 1919 - Occasional.

New York: 1918 - Common on Transparent, Bough (Sweet Bough), Pound Sweet.

California: 1917 - Fairly serious.

Charles Brooks and D. F. Fisher, (Office of Fruit Disease Investigations, United States Department of Agriculture) furnish the following data for the Pacific Northwest:

"Most susceptible varieties: Tompkins King, Winesap, Delicious, Newtown, and certain summer apples - Red Astrachan and Waxen in particular. Not as serious in the Pacific Northwest in 1919 as in 1918. Influence of irrigation and fertilization not established."

Drouth spot (non-parasitic).

"The term drouth spot is used to refer to masses of dry corky tissue in the flesh of the apple. The spots are usually much larger and more deeply seated than bitter pit spots. The disease was far less prevalent than in 1918 but caused some losses on York Imperial in Virginia, West Virginia, Maryland, and Pennsylvania." Charles Brooks (United States Department of Agriculture). Idaho (Hungerford) reported drought spot and cork in 1919 as follows: "This trouble has been reported from various sections of the state where apples have been grown without irrigation and with insufficient moisture."

Storage scald (non-parasitic)

"Several varieties of apples were held rather beyond their usual storage season (1919-1920) but the cold weather that prevailed made it possible to market them in most cases without heavy losses from scald. Grimes showed scald on the markets by the middle of December, and York Imperial and Black Twig by the middle of January. Apples in baskets, boxes, or ventilated barrels scalded less than those in the usual tight barrels. Apples in unoiled wrappers scalded as badly as unwrapped apples but those in oiled wrappers remained free from scald." Charles Brooks, United States Department of Agriculture.

In the following table it will be seen that of the 2,973 cars of apples inspected by the Bureau of Markets inspectors in 1919, 48 cars were affected with scald, 11 from eastern and 37 from western states.

Table 34. Losses from scald caused by physiological conditions as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with scald	Average percentage of scald	Range of percentage of scald	Remarks as to seriousness of scald
New York	1	9	7-12	
Delaware	1	6	6	Slight scald.
Pennsylvania	1	8	5-10	Deep scald.
Virginia	6	20	5-45	Some bad scald.
West Virginia	1	40	40	Affecting one-third to two-thirds of surface of affected apples.
Michigan	1	100	100	All degrees of severity.
Washington	35	15	2 cars 50-100	Slight scald on large percentage of fruit.
			33 cars 2-27	All degrees of severity.
Oregon	1	7	7	
California	1	20	20	Slight scald.
Total.....	48		Total number of cars inspected - 2973.	

Sun scald (non-parasitic)

New Jersey (Cook): Sunburn very severe and the cause of heavy losses due to exceptionally hot weather on July 4 and 5. Ohio (Selby): Relative prevalence about same, resulting from excessive exposure of upright stems, reported May 5. Virginia: Some injury in early August during exceedingly hot weather.

Winter injury caused by low winter temperatures.

Connecticut: Effects of severe winter of 1917-18 still evident in injured and dying trees. Pennsylvania: Crotch injury on York Imperial in Franklin County and brown pith in twigs of Northern Spy in Wayne County. Both may have been caused by winter of 1917-18. Ohio: Relative prevalence less, cases reported largely carried over from 1918. Idaho: Rather serious winter injury in Kootenai County. Washington: Reported from several localities in western, central, and eastern districts.

Spring frost injury.

Frost injury in 1919 was reported by several states. Connecticut: Late frosts in May hurt blossoms considerably in certain localities, so that crop was light in places, some injury to leaves. Pennsylvania: Foliage severely injured at Phoenixville, Pa., 20% of foliage showed marked blisters (May 5). West Virginia: Foliage of many varieties injured by late frosts. The cold weather which prevailed at blossoming time resulted in much injury to them, apparently not due to frost, but to cold windy weather. Fruit set was comparatively light as a result. Ohio: Frost banding reported from Lawrence County, June 25, as bad on Ganc variety. Indiana: Frost on April 25, 26, 27 was very prevalent and state-wide. Injury was very severe. In the southern part of the state peculiar scarred areas about the calyx end, and the familiar frost band was common while in the northern part of the state in many cases the frost resulted in the total destruction of the blossom. Illinois: (Anderson) "There has been an unusual amount of leaf yellowing and dropping this season. There was a frost with temperatures of 24-30° throughout the state April 26-27. The apples were in full bloom in central Illinois at this time. This was followed by good growing weather until the week of May 19-24, when there were several days of cold, rainy weather. This was followed by very warm, dry weather. The older leaves suffered most. The condition was noticed on other fruits also." Montana: Slight russeting in certain localities. Idaho: Frost banding reported from the Panhandle. Washington: Severe spring frosts caused more than usual injury, much young fruit killed by the late frosts, especially in eastern Washington, frost blistering and curling of leaves very common throughout the state.

Fall frost and freezing injury.

"Heavy losses from freezing were sustained on northwestern apples in transit. The losses were brought about by inability to get suitable cars, abnormally cold weather, and unusual delay in shipments." (Charles Brooks, United States Department of Agriculture).

Oregon reported "Hood River Valley apple crop damaged 4% to 5% by severe frost. Some damage to fruit on trees and in boxes still in orchard." (Bureau of Crop Estimates, Weekly Crop Notes, Oct. 26 to Nov. 1, 1919.)

Hail injury (non-parasitic)

Michigan (Coons): Hail injury common in Oakland County.

Spray injury.

Sulphur sun scald of apples in the interior regions of the Pacific Northwest, east of the Cascade Mountains, is reported as follows by D. F. Fisher and Charles Brooks (United States Department of Agriculture):

> "Occurs following application of sulphur in any form during the period of intense sunlight when shade temperature exceeds 90° F. Only apples exposed to the direct rays of the sun during the hottest parts of the day are usually affected. Foliage injury accompanying the fruit burning is ordinarily inconsequential. Has been known to occur fully 3 weeks after sulphur was applied, - when burning temperature was thus delayed. Mildew control after the early spring season is greatly complicated by the practical certainty of sulphur sunscald resulting from application of the most effective spray materials."

Idaho (Hungerford) reported slight loss by burning from lime sulphur from northern and southern counties.

New Jersey (Cook) stated: "Spray injury very common where concentrated lime-sulphur 1 to 40 was used as a summer spray".

John W. Roberts (United States Department of Agriculture) stated concerning spray injury in Virginia, West Virginia, Maryland, and Delaware in 1919: "Spray injury from lime-sulphur and from Bordeaux mixture was more than usually severe".

Connecticut reported, "Bordeaux, lime-sulphur, copper lime sulphur, calcium arsenate (liquid) all caused trouble, although calcium arsenate in the dry form apparently caused less injury than when wet. Bordeaux injury consisted mainly in russeting of the fruit."

Ohio (Selby) reported, "No cases of arsenical injury clearly evident. Clear evidence of danger from high pressure with spray gun". The cause is given as "mechanical - large disc and particles in sprays". Instances of 40% injury to the crop were cited, resulting from leaf drop. In a letter from D. C. Babcock, June 19, 1919, (Ohio) it was stated: "I have noticed some damage from the use of the spray gun on apple foliage and the leaves on some of the trees were burned to an extent of probably 75%. The conclusion was that the operator had manipulated the gun too close to the foliage."

Pennsylvania (Orton) reported: "Sodium arsenate defoliated trees sprayed by the State Department at Harrisburg (Wyoming County)".

Virginia (Fromme) reported: "A good deal of complaint of spray burn, especially on foliage from early summer applications."

SUMMARY - Sprays and dusts reported as causing injuries in 1919.

Material	Locality	Injury
Bordeaux Mixture	Md., Va., W.Va., Del.	Injury more severe than usual.
	Conn.	Injury - mainly russeting of fruit.
Sulphur	Pacific Northwest	Sulphur in any form liable to cause trouble.
Lime-Sulphur	Md., Va., W.Va., Del.	Injury more severe than usual.
	N. J.	Injury very common, where concentrated lime-sulphur diluted 1-40 was used as summer spray.
	Idaho	Slight.
Calcium Arsenate	Conn.	Less injury when dry form was used.
Sodium Arsenate	Pa.	Caused defoliation.
Spray injury from using spray gun with too high pressure	Ohio	

Miscellaneous fruit rots and spots

Fruit rot caused by Alternaria sp.

Colorado: Winesap especially susceptible. Reported on several cars shipped out of state.

New Jersey: Blossom end rot (Alternaria sp.) common but not serious.

Washington: Alternaria sp. caused rot of fruit at Pullman, Febr. 10, 1919, but less serious than the Penicillium rot.

NOTE: Mel. T. Cook (New Jersey) reported Alternaria sp. causing Jonathan spot, and the disease very abundant.

Pink rot caused by Cephalothecium roseum (Fries) Cda.

New Jersey: Common, but of little importance.

Ohio: Occurred in October. Associated with black rot, aided by much late season rain.

Washington: Found Jan. 13, 1919 in Mason County.

Rot caused by Phytophthora cactorum (Lib. and Cohn) Schröt.

Connecticut: (Clinton) Apparently common; first report last year; small amount of injury on falling rotting apples under tree.

Late red spotting, cause doubtful (Barss).

Oregon: Apples having yellow skins, especially Yellow Newtown, are lately being reported as affected by small red spots, each centering in a lenticel and

resembling very closely the appearance of San Jose scale spots. The late picked fruit (and picking continued unusually late this year) in a good many orchards showed this effect. Rainy weather had occurred and rather low temperatures before such fruit was off. Copper sprays seemed to induce earlier and more abundant appearance of this condition.

Storage rots caused by various fungi.

"The unusual amount of small scab spots on the stored apples has resulted in larger losses than usual from storage rots." Charles Brooks, United States Department of Agriculture.

Miscellaneous leaf spots.

Cercospora mali - Texas (Taubenhaus) reported from Bexar and Guadalupe Counties, unimportant.

A silver leaf disease reported by Heald and Dana from Okanogan district, Washington, Mar. 26, 1919.

Miscellaneous bark cankers.

Brown bark spot (non-parasitic) reported by Heald and Dana from Stevens County, Washington.

Canker caused by Septobasidium pedicillatum (Schw.) Pat.
(Thelephora pedicillata Schw.)

This disease was reported by a county agent at Covington County, Miss., as abundant on limbs in an entire orchard.

A scurfy bark canker was reported by Leonian (N. Mex.) on some 700 Delicious trees. The trees of this variety were badly affected with the disease, while other trees in the same orchard were not at all affected.

Cytospora canker thought to be caused by Cytospora sp. and another undetermined fungus was reported from New Mexico by L. H. Leonian as follows:

"Widespread and very active in the final destruction of trees. Some orchards show as high as fifty percent infection but these organisms are only weak parasites and follow woody apple aphis, giant fruit tree borer, and presence of large amount of nitrates in the soil as has been demonstrated by digging out a large number of cankered trees, the roots of which were in all cases infested with either aphis or borer, or both. Analysis of soil showed nitrates in such large amounts as to be injurious to plants. Inoculation experiments with Cytospora showed that it was a weak parasite and unable to attack healthy trees."

Myxosporium corticolum (Edgerton) was reported by Clinton as occasionally occurring in Connecticut, probably following winter injury.

A bark canker showing fruiting bodies of Rhabdospora rhoina (Peck) was reported by Bisby (Minnesota) as follows:

> "Bark canker, one report from Hennepin County. The canker was 6-10 inches broad, bark gray - similar to gray bark of raspberry. The pycindia are sub-epidermal. First report for Minnesota, June 13, 1919."

A bark canker showing Radulum aterrimum (Fries) was reported by Bisby from Ramsey County, Minnesota. The organism seemed to be causing a distinct canker. This is the first report for the state.

Schizophyllum commune (Fries) was reported as common in Ohio, Missouri, and Minnesota.

"Measles" - Leonian (New Mexico) reported concerning this disease in 1919:

> "Very common and destructive. Affected trees remain stunted for years and eventually die. The bark shows purplish small pustules in large patches. Spots in which affected trees grow enlarge from year to year forming circular areas where only a few plants can grow and the trees become invariably measled. Soil from these spots has been analyzed showing the presence of nitrates and carbonates in such large amounts as to be positively injurious to the growing things."

Virginia reported "Measles" from Patrick County, March 10, 1919, and stated it was apparently the same disease as that described by Hewitt, Bulletin 112 of the Arkansas Experiment Station.

ROOT ROTS

Armillaria root-rot was reported common and causing a trace of loss in Arkansas. New York reported root-rot, probably Armillaria sp. causing local damage in Wayne and Monroe Counties.

Clitocybe root-rot was reported along with Armillaria (above) from Arkansas, as causing a trace of loss.

Ozonium omnivorum Shear was reported prevalent in Texas, causing 5% loss.

Xylaria root-rot was reported as follows:

Arkansas: General, trace of injury in Benton and Washington Counties.

Illinois: Black root-rot, Xylaria sp., scattered. very slight injury, disease found only in three or four orchards in the extreme southern parts of state.

Indiana: 0.5% loss, fairly common in southern Indiana.

Pennsylvania: Found, with fruiting bodies, August 20 in Franklin County: "First record in Pennsylvania as far as we know". (Orton). Loss slight, two trees out of 54 found in one orchard.

Miscellaneous root rots, unidentified, were reported as follows in 1919:

Missouri: Gano variety affected with undetermined root-rot in Marion County.
Ohio: Undetermined root-rot in three counties.
West Virginia: Slight loss from root-rot in Braxton and Monroe Counties.

"Collar rot" was reported as follows:
Ohio: Freezing and subsequent infection.
Washington: Very prevalent in central and eastern Washington.

PEAR

Blight caused by Bacillus amylovorus (Burr.) Trevisan.

This disease was reported in 1919 from practically all regions where the pear is grown. Greatest losses occurred in southern Indiana, and in certain states in the southeastern section of the country, namely, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Alabama, Mississippi, and Louisiana. The total production of pears in this area in 1919 was about 1,321,000 bushels, or not far from 10% of the total United States crop. Losses from pear blight were estimated at from 10 to 50% by states. Indiana reported 75% injury to the crop.

Heavy losses were also reported from Colorado and New Mexico. Leach (Colorado) reported the disease abundant, severe, and causing the usual amount of damage. Leonian (New Mexico) stated: "Sudden outbreak all over the state. Average loss about 10 to 15%. Most serious in the history of the pear industry in New Mexico. Formerly considered unimportant."

Moderate losses, not generally exceeding 1%, were reported from Vermont, Massachusetts, Connecticut, Rhode Island, New Jersey, Pennsylvania, Delaware, Virginia, Arkansas, and Texas.

In the West, Washington reported the occurrence of pear blight in a few localities. No reports, however, were received from the important pear state of California, where in 1919 the crop was estimated at 4,096,000 bushels, only a little short of the combined production of the four next largest pear producing states of this year, Washington, New York, Oregon, and New Jersey.

Oregon reported the disease severe in Josephine County. In the Rogue River Valley, where the pear industry was threatened with extermination by this disease, a course of vigilant eradication has proven highly successful. This work was begun by M. B. Waite in 1906 and carried on for several years by P. J. O'Gara. In late years Mr. C. C. Cate, County Pathologist at Medford, has conducted the orchard inspection and eradication. The work has been regarded as a community problem. Hold-over cases in top, body, collar, and root have been systematically looked for and the infected parts destroyed.

An important step in the success of this campaign against pear blight in Oregon has been the detection and eradication of collar blight, working along lines similar to those developed by M. B. Waite, in the California orchards in 1905-06 and '07, (see below). Collar cases, though perhaps entirely

beneath the soil, have been located and eradicated. It has been observed that this form of the disease, even though not visible above ground, is a source of blossom infection and may initiate an outbreak of blossom blight. Excavating about the collars of all trees in an orchard, frequently reveals several such hold-over cases. In instances where blossom blight has been epiphytotic, although eradication in tops and bodies had been practiced by experienced men, the source of first blossom infection has been traced to these buried hold-overs, and their eradication has had an important influence in controlling the disease. The experiment of producing blossom blight with the pear blight organism isolated from collar blight cases was repeated by the writer (Hutchins) from the collars and from the tops of pear trees, Idaho variety, at Wenatchee, Washington, in November, 1919. The organisms were kept in pure culture and inoculated into Kieffer pear blossoms at the Experimental Farm of the United States Department of Agriculture, Arlington, Virginia, in April, 1920 - producing typical blossom blight in both cases.

M. B. Waite, (United States Department of Agriculture) furnishes the following statement concerning the occurrence of the collar blight form of pear blight:

> "This form of pear blight has proved one of the meanest forms of this disease in eradication and control work, partly because it is rather difficult to find on account of the thick and rough, scaly bark at that point, and partly because a small area of the blight does the maximum amount of damage to the tree. Its attacks are extremely erratic and appear to bear no very direct relation to the amount of the various forms of top-blight on the trees. It was found abundantly by me at Montrose, Delta, Peonia, and Grand Junction, Colorado, mostly on Bartlett pears, in 1903 and 1904. In the California campaign on the eradication of pear blight, it was found in a great many orchards of that state, both in the San Joaquin and the Sacramento Valleys and in adjacent smaller valleys in 1905, 1906, and 1907. Some orchards with an abundance of top-blight had little trouble at the collars of the trees, while other orchards having only a moderate amount of top-blight were badly attacked by this aggravated form. A special method had to be adopted for locating it. This was as follows: A three-fourths inch gouge with the bevel on the outside was carried by the inspector, and a little concave chip one-half inch in diameter, was made through the rough bark, exposing the greenish-white live inner bark. A sponge with a sublimate solution was carried and each cut was saturated with this solution and the gouge wiped before making the next. The Bartlett pears were usually gouged on each side and if any considerable quantity of collar blight was found, a second set of gouge marks was made on the opposite sides between the first cuts. When the gouge-mark showed the blight, the case was followed up and eradicated. Many beautiful and apparently sound trees with no blight in the tops (there being blight nearby in the orchard) were found affected at the collar. Collar blight was found in the outbreak at Medford, Oregon, in the autumn of 1906, and in subsequent years. In 1907 and for some six years thereafter, P. J. O'Gara conducted a strenuous fight against it along with his other efforts to eradicate blight in that region. At Walla Walla, Washington, in the extensive Blalock Orchards, a number of striking cases were found with still

more abundant body blight and various forms of top blight. In 1906, at Payette, Idaho, a number of cases of collar blight on Bartlett, and perhaps other pears, were located.

"In the bad outbreak of pear blight on the Bartlett pears in western New York from 1903 to 1907, a great many cases of collar blight were found, especially in Niagara, Monroe, and Orleans Counties. These occurred in the presence of still greater quantities of body blight and tip blight."

For occurreme of this disease on other hosts see apple (page 115), pear (page 138), quince (page 143), plum (page 159), and loquat (page 178).

Scab caused by Venturia pyrina Adehr.

This disease was reported in 1919 by only a partial list of the states in which it occurs. Vermont reported severe loss; Pennsylvania - 2% loss; New Jersey - common in neglected orchards; Connecticut - some; Delaware - about 1% loss; Ohio - less, crop short; Indiana - rare; Washington - severe in western, none in eastern parts of state.

Black rot caused by Physalospora cydoniae Arnaud.

Black rot was reported from Stark County, Ohio (Selby) as "rather less, earliest report September 7, Bordeaux sprays in July good", and from Arkansas where it was common. Inspectors of the Bureau of Markets reported it as follows:

Table 35. Losses from black rot as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay	Remarks as to seriousness of decay.
Arkansas	2	24	20-28	
Georgia	3	23	5-45	
Illinois	4	22	10-43	Considerable complete decay.
Indiana	1	40	40	(Rhizopus).
Missouri	3	10	2-25	Estimate includes some blue mold.
Oklahoma	2	15	10-20	Estimate includes some brown rot.
Texas	3	19	1-37	Decay heaviest in top of loads.
Wisconsin	1	9	9-10	One-fourth of decay complete.
Unknown	1	43	40-45	Decay mostly in spots, occasional pear completely decayed.
Total.....20			Total number of cars inspected ..... 270.	

Blue mold rot, caused by Penicillium expansum (Lk.) emend. Thom

Rotting of fruit in transit, caused by the P. expansum, was reported as follows by Bureau of Markets inspectors:

Table 36. Losses from blue mold rot as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay	Remarks as to seriousness of decay.
California	3	33	2-5	Most of decay occurred in top of loads.
Colorado	3	15	7-20	Estimate includes some brown rot.
Illinois	2	6	3-10	Mostly slight decay.
Michigan	1	--	0-75	Most baskets showed no decay.
Missouri	1	27	25-30	Estimate includes black rot.
New Mexico	2	2	2	Slight decay.
New York	1	5	4-5	
Washington	5	5	1-13	All stages of decay, considerable complete decay.
Unknown	1	21	20-22	Mostly in spots.

Total.....19 Total number of cars inspected ..... 270.

Soft rot caused by Rhizopus sp.

Losses caused by soft rot of fruit in transit were reported as follows in 1919 by inspectors of the Bureau of Markets.

Table 37. Losses from soft rot as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay	Remarks as to seriousness of decay.
California	10	8	2-15	Mostly slight decay.
Illinois	1	80	75-85	From 1 to 6 spots on affected stock.
Indiana	1	57	55-60	
New Jersey	1	43	40-45	Two-thirds in spots, balance complete.
New York	6	10	5-23	Considerable complete decay in one car.
Washington	4	6	2-13	Mostly in advanced stages.
Wisconsin	1	5	5	

Total.....24 Total number of cars inspected 270

Brown rot caused by Sclerotinia sp.

South Carolina in 1919 reported brown rot common where pears where held in storage. Losses from this disease on fruit in transit was reported as follows by inspectors of the Bureau of Markets:

Table 38. Losses from brown rot as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay	Remarks as to seriousness of decay.
Alabama	1	42	42	Average for the load.
Colorado	1	20	20	Estimate includes blue mold
Illinois	1	17	15-20	Spots ranging in size from a dime to one-third of surface.
New York	1/2	11	10-12	Spots one-eighth to one-half inch in diameter.
Texas	1	53	50-55	
Total.....4 1/2			Total number of cars inspected 270	

Fabraea maculata (Lev.) Atk.

New Jersey reported this disease in 1919: Very abundant and very destructive in some orchards, especially in the southern part of the state. Delaware reported it very prevalent throughout vicinities of Woodside, Wyoming, and Dover, where 50% loss occurred in some orchards.

Crown gall caused by Bacterium tumefaciens Sm. & Towns.

Crown gall was reported as follows in 1919: Arkansas: general; Arizona: a serious menace to all kinds of fruit trees including pear; Washington: present in Kittitas County.

Other diseases.

Phytopthora rot, caused by Phytophthora cactorum (Lib. & Cohn) Schröt., was reported as follows by Clinton, (Connecticut): "New to the state, but apparently common this year. Percent of injury small, found chiefly on fallen fruit rotting under trees. Only mycelium present in fruit, but in cultures oospores were produced abundantly".

Sooty blotch, caused by Leptothyrium pomi (Mont. & Fr.) Sacc., was reported causing 1% or less injury in Delaware.

Brown blotch, cause uncertain, was reported common by Cook, in New Jersey.

Powdery mildew, caused by Podosphaera leucotricha (E. & E.) Salm., was reported from Pierce County, Washington (Heald & Dana). First appearance June 30, 1919.

Leaf spot, caused by Phyllosticta pyrina Sacc. One specimen was received by Maneval, from Cole County, Missouri.

Leaf spot, caused by Mycosphaerella sentina (Fr.) Schrot. (Septoria pyricola) was reported April 16, 1919, from two localities in southeastern Alabama.

Armillaria mellea Vahl. was reported by Heald as causing considerable trouble in an orchard near Olympia, Washington.

Ozonium omnivorum Shear was reported by Taubenhaus from five counties in eastern Texas.

Chlorosis (non-parasitic) was reported in 1919 from New Mexico by Leonian as "generally present. In extreme cases leaves turn white, then brown, and die. Trees may be entirely defoliated". In serious cases trees are dwarfed. First report - May.

Drought injury reported by Heald and Dana from southeastern Washington.

Failure of blossoms to set was reported in 1919 from Delaware (Manns), as resulting in a very light crop. This behavior was attributed to an unfavorable season.

Winter injury was reported from western, southern, and eastern Washington (Heald & Dana). An orchard of dwarf pears near Olympia was mentioned as being severely injured.

QUINCE

Fire blight caused by Bacillus amylovorus (Burr.) Trevisan.

Fire blight on quince in 1919 resulted in about normal losses in New Hampshire, Connecticut, and New Jersey. Delaware reported the disease less severe. Pennsylvania reported relative prevalence as usual, considerable injury with slight loss, earliest report June 5 in Center County, early maturing of wood checked the disease. In Ohio losses by blight were much less than usual, which was attributed to killing of the blossoms by late frost. South Carolina and Texas reported a trace of injury.

Leaf blight caused by Fabraea maculata (Lev.) Atk.

This disease in 1919 was reported from New Jersey (abundant and very severe), and from Illinois (very abundant, no crop on account of frost, leaves lost by August 1. First appearance May 20 at Lilly, Illinois.)

Other diseases.

Crown gall caused by Bacterium tumefaciens Smith & Towns. reported from King County, Washington.

Black rot caused by Physalospora cydoniae Arnaud was reported in 1919 from New Jersey (very abundant and very severe), Delaware (common, 5% injury), and Ohio (more severe than usual).

Brown rot caused by Sclerotinia sp. was reported from Pierce County, Washington.

Powdery mildew caused by Podosphaera leucotricha (E. & E.) Salm. was reported by Heald and Dana from Pierce and Jefferson Counties, Washington.

Rusts were reported as follows in 1919: Gymnosporangium clavipes C. & P.- very severe locally in Montgomery County, Virginia. The earliest report was from Christiansburg, July 10.

Gymnosporangium clavariaeforme (Jacq.) DeC. was reported from Belknap and Rockingham Counties, New Hampshire, June 23.

Gymnosporangium germinale (Schw.) Kern was reported from New Jersey as occasional.

DISEASES OF STONE FRUITS

PEACH

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt.

Brown rot was very prevalent in most of the peach states in the eastern half of the country during 1919. It was reported from all states where peaches are grown east of the 100th meridian and was present to some extent up and down the Pacific Coast. Rotting of the fruit was the most common and important form of the disease, but in the Middle Atlantic States and New England much damage also was done in the spring by blossom and twig infections. In New York, New Jersey, Delaware, and Maryland blossom blight was extremely serious.

The year 1919 may be said to have been "bad" as far as brown rot was concerned. New England, New York, Ohio, and all states east of the Mississippi and Ohio Rivers reported considerably more than usual, while in the Middle Atlantic States the disease was epiphytotic. In Michigan, Indiana, Illinois, and states west, however, brown rot seemed to be present in about normal or slightly sub-normal amounts.

Estimates of losses from the disease, as it occurred in the orchard, have been made and the percentages are presented on the accompanying map. The losses in bushels will appear in Plant Disease Bulletin Supplement 12, 1920.

It will be noted that in some states the losses were very high. In Delaware 50% reduction in yield is estimated. This is quite largely on account of blossom and twig blight. T. F. Manns estimated that 50% of the blossoms in Delaware were destroyed during the latter part of April. It was so severe in many of the old orchards as to totally destroy the crop. Many cankers which are sure to badly affect the future vigor of the trees, were found. J. M. LeCato made estimates of blighted blossoms in a number of orchards in Sussex County, Delaware, April 28-29. His estimated percentage reductions in yield in individual orchards were as follows: 10%, 10%, 20%, 80% (old orchard), 1% (young orchard), 1% (young orchard), 20%, 5%, 55%, 1-2%, 5%, 75%, 25-80%, 40%,

In New Jersey, Cook reported the crop on some trees practically all destroyed from blossom blight. He also stated that it was worse in the old than in the young orchards. He mentioned the cankers on 1918 wood as being a very important source of infection. In New York blossom blight was general in the important peach counties along Lake Ontario. In Wayne County, New York, 50% of the trees were affected, while in Monroe and Orleans Counties as high as 90% blossom infection was reported in individual commercial orchards. In Maryland 90% of the blossoms in some orchards were killed by Sclerotinia in the early spring. In Georgia, brown rot of the fruit was general and caused losses in the field averaging about 20%, but running as high as 100% in some cases. In Louisiana brown rot was serious on what few peaches were grown. One three-acre orchard with a full set of fruit at Avery Island, Louisiana, was a total loss.

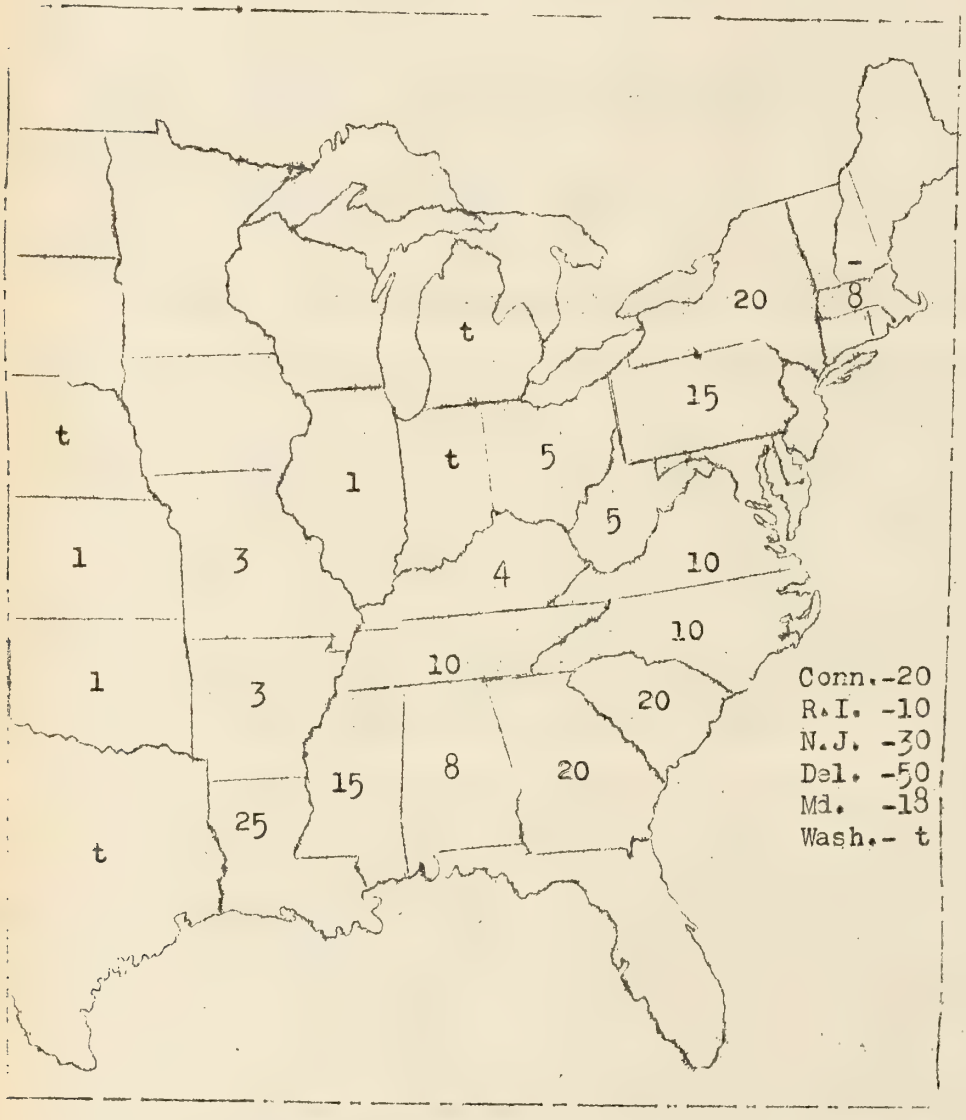

Fig. 29. Estimated percentages loss from peach brown rot, 1919.

The losses from brown rot to fruit in storage, transit, and market were also exceedingly heavy. The best sources of data on this subject are the reports of the food products inspectors of the Bureau of Markets. These men made inspections of 1644 cars of peaches during the calendar year 1919 and found more or less brown rot in about 1150 of these shipments. Table 39 following gives their results more in detail.

Table 39. Percentages of peach brown rot as found in cars at destination by inspectors of the Bureau of Markets, 1919.

Origin of shipment	No. cars with decay	Average % decay	Range of decay: No. cars	Range of decay: Percentage	Origin of shipment	No. cars with decay	Average % decay	Range of decay: No. cars	Range of decay: Percentage
Alabama	10	24	7	8-20	New Jersey	5	26	5	10-38
			3	29-60	New York	41	15	36	2-25
Arizona	1	15		5-25				5	38-45
Arkansas	67	14	56	1-25	Ohio	1	5		5
			11	27-50	Oklahoma	65	13	52	1-25
Calif.	6	20		10-30				3	27-45
Colorado	23	11		5-35				4	57-87
Delaware	3	25		12-40	Penn.	10	28	6	6-21
Florida	1	10		3-17				3	35-55
Georgia	615	25	362	1-25				1	80
			219	27-50	Texas	137	17	114	3-25
			34	55-90				18	27-50
Idaho	2	9		5-13				5	52-75
Illinois	7	13		3-30	Utah	28	5		1-21
Indiana	1	10		10	Virginia	5	27		12-40
Maryland	54	15	44	1-25	Washington	4	8		1-13
			10	28-60	W. Virginia	20	29	13	5-25
Michigan	1	30		30				3	30-40
Missouri	38	13	34	1-25				4	55-75
			4	30-80	Unknown	4	39		23-65

Total...1149

Number of cars of peaches inspected...1644

The complaint about the rotting of southern peaches in northern markets was very general last year. Many wholesalers and retailers lost heavily because of brown rot. It will be seen that the aggregate losses from this disease in the field, in transit, and in marketing were enormous.

Warm, moist weather is favorable for brown rot. Although collaborators did not report much about weather conditions, it is known that the wet weather at blossoming time in the Middle Atlantic States induced blossom blight in that section, and that the frequent summer rains favored the development of fruit rot in all the eastern and southeastern states.

The dates when the disease first became evident on the new growth were reported by collaborators as follows:

April - Delaware (blossom blight)
" - New Jersey(" ")
" - Arkansas (" ")
May 15 - South Carolina
" 25 - Pennsylvania (twig blight)
" 26 - Alabama
June - Mississippi (fruit rot)
June 1 - Tennessee (" ")
June 6 - Virginia (" ")
July - Oklahoma (" ")
July - Illinois (" ")

Peach varieties differ considerably in their susceptibility to brown rot. Of commercial varieties it is known that Champion and Carman are very susceptible The data received on this subject in 1919 is summarized in Table 40.

Table 40. Data on varietal susceptibility of peaches to brown rot, as given by collaborators, 1919.

Variety	State	Remarks as to susceptibility.
Belle of Georgia	Delaware	60% blossom blight in Sussex County.
Carman	Delaware	95% " " " " "
	New York	Badly affected with blossom blight.
	Virginia	50% loss at Warrenton in spite of 3 sprayings.
Champion	Connecticut	Susceptible
	New York	"
	Pennsylvania	100% infection in Adams County.
	Virginia	Especially susceptible.
Early Rochester	New York	Susceptible.
Elberta	Arkansas	Bad blossom blight.
	Delaware	50% blossom blight in Sussex County.
	New York	Susceptible to blossom blight.
Hale	Arkansas	Bad blossom blight.
Niagara	New York	Susceptible to blossom blight.

Self-boiled lime sulphur is commonly used in commercial orchards to combat brown rot. In general it has given good results and has been the means of saving many thousands of bushels of peaches. However, there is still room for much improvement along the lines of an efficient summer spray for peaches. Trials with the use of sulphur and arsenate of lead dust for peach pests have been made during the last few years with rather promising results. In 1918 New Jersey, Delaware, Virginia, West Virginia, and Georgia reported favorably. In 1919 a questionnaire was sent to collaborators asking for "opinions as to the value of sulphur dust in the control of peach diseases" and replies were received as follows:

Connecticut: "Dusting seems to be coming in a little more than past years, but as yet is used in only a limited way." Clinton.

Virginia: "Fully as satisfactory as liquid for curculio and scab, but decidedly inferior for brown rot." Fromme.

West Virginia: "I may say that our opinion has not changed very much as to the value of sulphur dust. I am a little dubious as to its value in controlling peach brown rot." Giddings.

Tennessee: "Sulphur dust used very little, if any, in control of fruit diseases." Essary.

Arkansas: "No data from station tests. Some large orchards have turned out perfect fruit and use only dust." Elliott.

Michigan: "Questionable."

During the season of 1920 a considerable number of dusting experiments will probably be conducted in the East. One of the activities of the Advisory Board of the American Phytopathological Society is a project on dusting orchard fruits under the leadership of N. J. Giddings of West Virginia. A group of pathologists, entomologists, and horticulturists met in Washington March 11, 1920, and drew up a plan for cooperative peach dusting experiments. This plan was distributed to interested persons in the peach growing states, with the hope that they would conduct experiments along the lines of the program, conforming to it as closely as possible.

The experiment was designed to answer such questions as:-,

1. Is the program that is recommended by dust manufacturers, and which is now being used by many orchardists, satisfactory?
2. What is the best formula?
3. Will an additional late application of dust afford better protection?
4. Can reduced quantities of sulphur be used?
5. How can blossom blight be controlled by dust?

The following table is an outline of an experiment planned to help solve some of these questions.

Table 41. Schedule of applications in cooperative peach dusting experiments for 1920, as recommended by the committee in charge of the dusting project of the Advisory Board.

Plot No.	Pink Spray	First Application	Second Application	Third Application	Fourth Application
1.		80-10-10	80-10-10	80-10-10	
2.		0-90-10	80-10-10	80-20-0	
2a.		0-90-10	80-10-10	80-20-0	80-10-10
3.		0-90-10	50-40-10	50-50-0	
4.	Control (sprayed plot)	Arsenate of lead 1.5 lbs; lime 3.5 lbs; water 50 gal	Self-boiled lime sulphur 8-8-50+2.5 lb arsenate of lead	Self-boiled lime sulphur 8-8-50	

Plot No.	Pink Spray	First Application	Second Application	Third Application	Fourth Application
5.	Check (untreated plot)				
6.	80-10-10	80-10-10	80-10-10	80-10-10	
7.	80-20-0	0-90-10	80-10-10	80-10-0	
8.	50-40-10	0-90-10	50-40-10	50-50-0	

Sulphur - lime - arsenate of lead is the order followed in the above formulae.

Time of application -
Pink spray - when blossoms show pink.
1st application - as calyces are falling.
2nd application - 4-5 weeks after petal fall.
3rd application - one month before ripening.
4th application - seven to ten days before harvest.

Size of plots - about 50 trees in treated plots, fewer in checks.

Materials - 90% of sulphur should go through a 200-mesh sieve.
Best grade of dehydrated lime is essential.
Arsenate of lead should run 80-100 cubic inches per lb.

Machinery - power machines should be used.

Leaf curl caused by Exoascus deformans (Berk.) Fckl.

Peach leaf curl probably had about its usual range in 1919. With the exception of Florida, Louisiana, and some of the dry land states, it was reported from practically all states where peaches are grown. In Georgia it was particularly mentioned as being much more important in the northern than in the southern half of the state.

In general the disease was considerably worse than usual. In many of the eastern states, particularly those along the coast, curl was epiphytotic. New Jersey, Delaware, Pennsylvania, Maryland, and Georgia all reported the worst attack in recent years and collaborators in New York, Ohio, West Virginia, Virginia, Indiana, and Michigan stated that the disease was more prevalent than usual. The abundance of the disease was doubtless attributable to the cold, wet weather early in the spring, which favored infection and made it impossible to apply the dormant spray on time. In many of the states where the disease was bad, it was mentioned that it was prevalent even in sprayed orchards. This was undoubtedly because they were sprayed too late.

Loss estimates have been made by states and will be given in detail in Plant Disease Bulletin, Supplement 12, 1920. The percentage figures are also given in the following table.

Table 42. Estimated percentages by states of the reduction in yield of peaches because of leaf curl in 1919.

States	Per cent	State	Per cent	State	Per cent
Mass.	1	S. C.	2	Mo.	t
Conn.	1	Ga.	7	Nebr.	t
R. I.	1	Ala.	t	Kans.	t
N. Y.	5	Miss.	t	Colo.	*0
N. J.	6	La.	0	Idaho	1
Pa.	5	Texas	t	Wash.	1
Dela.	8	Okla.	t	Ore.	*-
Md.	10	Ark.	t	Calif.	*-
Va.	3	Ohio	3		
W. Va.	5	Ind.	1	*- = Occurrence, no data as to loss.	
Ky.	1	Ill.	t		
Tenn.	1	Mich.	2	*0 = Occurrence, no loss.	
N. C.	3	Ia.	t		

Nearly complete defoliation was reported from some unsprayed home orchards in Delaware and Georgia, and in Massachusetts a case of fruit drop resulting from curl was observed. In Pennsylvania, where the worst outbreak in recent years occurred, an average of 10-25% defoliation was estimated for the state. In Juniata and Erie Counties, Pennsylvania, as high as 90% infection took place.

Varietal differences were not mentioned by collaborators in 1919 except in Tompkins County, New York, it was noted that even those varieties that were supposed to be fairly resistant to leaf curl were rather badly attacked.

The failure of the early spring spray to control leaf curl in a number of states last year is an argument in favor of fall spraying. In the fall the weather and condition of the soil are apt to be much more favorable for spraying than in a cold, wet spring, such as was experienced in 1919.

Scab caused by Cladosporium carpophilum Thüm.

Scab was reported from practically all peach states east of the 100th meridian. It was common and wide-spread in most of these states and seemed to be of most importance in those in the South and East. In general it occurred in about the same amounts as usual, although along the Atlantic Coast from Maryland to Massachusetts it was probably above the average. In New Jersey it was mentioned as doing more damage to the leaves than usual, while in Mississippi it was said to be very abundant both on the 1918, and the current years, twigs.

The losses were brought about chiefly by lowering the market value of the fruit. Collaborators' estimates of injury are given in Table 43.

Table 43. Injury and losses from peach scab according to collaborators in 1919.

State	Percentage affected fruit	Percentage loss	State	Percentage affected fruit	Percentage loss
Arkansas	1	t	Mississippi	20	-
Delaware	5-15	-	Missouri	Moderate	t
Florida	25-30	-	Pennsylvania	-	2-5
Georgia	15	3	South Carolina	20	1
Illinois	t	0	Texas	-	1
Indiana	t	0	West Virginia	10	2
Iowa	t	0			

Considerable amounts of scabby peaches found their way into the markets as is shown by the following table.

Table 44. Percentages of peach scab as shown by inspection of cars at destination by inspectors of the Bureau of Markets.

Origin of shipment	No. of cars with scab	Average percentage of scab	Range of percentage of scab	Remarks as to seriousness of scab, etc.
Arkansas	43	14	41 cars 1-3%	
			2 cars 85%	Very bad scab.
Florida	1	27	25-30%	Scab and scars.
Georgia	39	16	37 cars 1-30%	
			2 cars 95%	Almost all stock affected.
Illinois	3	5	1-10%	Slight scab.
Maryland	9	14	5-28%	Other blemishes included.
Missouri	9	23	7 cars 2-18%	
			2 cars 50-100%	Includes hail marks, mildew, etc.
Ohio	1	22	20-25%	Slight scab.
Oklahoma	13	10	2-17%	Includes some insect injury.
Pennsylvania	2	5	5%	Scab found in an occasional basket.
Texas	42	17	40 cars 2-30%	Includes other blemishes.
			2 cars 63-100%	Mostly specks.
Virginia	1	17	15-18%	
West Virginia	3	18	2 cars 2-6%	Scab and other blemishes.
			1 car 50%	Bad scab.
Total.....166			Total number of cars inspected ..... 1644.	

Elberta was said to be less affected than Carman in Connecticut, and in Adams County, Pennsylvania, both the Fulton and Greensboro varieties were badly attacked.

Spraying with self-boiled lime sulphur was satisfactory in Virginia, Georgia, and Arkansas, according to collaborators. Sulphur dust also gave splendid results in a number of eastern states where it was tried. The tests with this material indicate that it will prove to be a very good fungicide for scab control.

Yellows, little peach, rosette, etc. (causes unknown).

Yellows was reported in 1919 from Massachusetts, Connecticut, New Jersey, New York, Delaware, Pennsylvania, and Ohio. A case supposed to be this disease was also reported from Louisiana, but inasmuch as Louisiana is somewhat outside the area where yellows is common, it is possible that the disease was not the true yellows, but rosette or some allied trouble. In New York the disease occurred, especially on Long Island but slight amounts were found locally in the western part of the state. In most of the states it was said to be present in about the usual amount, but in Massachusetts it seemed to be more prevalent than during the last few years.

Few estimates of losses are made, but Delaware estimated 1/2-1% and Pennsylvania 4-5% of the trees affected. The one case reported from Louisiana was a small orchard of 12 trees in Rapides Parish that was a complete failure.

No attempts have yet been made in Pennsylvania to eliminate yellows by an inspection service according to collaborator C. R. Orton.

Little peach was specifically mentioned as occurring in Delaware, New Jersey, and Kansas. The trouble in Kansas may not be the same as that in the other states.

Rosette was reported from Georgia by J. A. McClintock as follows:

> "Found scattered throughout commercial orchards of both young and old trees. Is gradually increasing in commercial orchards as well as in neglected ones. No varietal resistance observed."

The disease was also observed in Oconee and Anderson Counties, South Carolina.

So called "Phony peach" was reported by D. C. Neal from Georgia (Phytopath. Vol. 10: 106-109, 1920). According to Neal the disease has been present for some years in the peach belt of middle Georgia, where it seems to be more or less limited. It was also found on six year old seedlings at Fort Valley, Georgia.

Black spot caused by Bacterium pruni E. F. S.

More or less of this disease occurred rather widely in the South and East. It was reported from New York, New Jersey, Delaware. Virginia, Georgia, Alabama, Mississippi, Texas, Oklahoma, Arkansas, Ohio, Indiana, Illinois, and Missouri. It has never been reported from the Pacific Coast.

It seemed to be of most importance in Delaware, New Jersey, and the southern parts of Indiana, Illinois, and Missouri, and was moderately severe in Oklahoma and Texas. In Indiana it was said to be very prevalent on the wood causing cankers, and on the leaves; while in Illinois it was mentioned as unusually severe on the twigs, but only moderate on the leaves. In both states the fruit spot was not especially common.

The damage, as estimated by some of the collaborators, is as follows: Delaware - 10-15% loss; Georgia - 25% leaves injured; Texas - 1% loss; Arkansas - 1/2% damage. In Roanoke County, Virginia, heavy defoliation and fruit dropping occurred in certain instances. As a rule the disease does little damage in Virginia, however.

That soil fertility is an important factor with this disease is shown by the following quotations:

Georgia (McClintock): "Spraying seems to be of some value but the more vigorous trees in well cared for orchards appear to be less affected."

Virginia: (Fromme): "Lack of fertility and cultivation favor disease. Prompt application of nitrate of soda was beneficial."

Arkansas (Elliott): "Fertilizer gave good results."

Coryneum blight caused by Coryneum beijerinckii Oudem.

This blight, which is of especial importance on the Pacific Coast, was reported from Washington, Idaho (5% injury, 1/2% loss), Colorado (western part), and Virginia. The occurrence in Virginia seems to be the first on record from that state. According to F. D. Fromme it was found June 1 in two orchards in Roanoke County, where the attack was severe, causing much defoliation with the result that many twigs were with fruit but no leaves. Twenty-five per cent loss of Carmans was estimated in these orchards, while the Elbertas were not so badly affected. The behavior of the disease under Virginia conditions should be closely followed, as the climate is somewhat like that of California, where the disease is very serious. Occurrences should be watched for also in all the eastern states.

Crown gall caused by Bacterium tumefaciens Sm. & Towns.

Crown gall is common on this, one of the more susceptible hosts. It is troublesome on peaches in many nurseries. In 1919 a report from Georgia indicated that much of the nursery stock in that and neighboring states was affected, and that one Georgia nursery showed 50% infection of peach trees. Although the disease occurred widely, it was only reported from New Jersey (common), Delaware, Ohio, West Virginia, Florida, Louisiana, Texas, Oklahoma, Georgia, and Arkansas.

Estimates of damage are as follows:

Delaware - 1% injury.
Georgia - 10% "
Texas - 1% loss
Arkansas - 2% injury.

Black mold rot caused by Rhizopus spp.

This rot was very common in shipments of peaches from all parts of the country, but particularly from the West. While brown rot was the chief market and transit trouble with eastern peaches, black mold rot claimed the greatest toll from the fruit shipped from the western states. In many of these shipments these two diseases were so associated that it was very difficult for inspectors to make any percentage estimates. They were made according to their best judgment and are presented in the following table:

Table 45. Losses from black mold rot as shown by inspection of cars at destination by inspectors of the Bureau of Markets, 1919.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay	Remarks as to seriousness of decay.
Arizona	1	12	7-18%	Associated with brown rot.
California	8	20	3 cars 30-55%	Brown rot also present.
			5 cars 2-15%	Slight decay.
Colorado	50	8	1-37%	Mostly slight decay.
Florida	2	17	2-32%	Bad decay in one car, slight in other.
Georgia	28	18	3 cars 55-85%	Associated with brown rot.
			3 cars 28-37%	Heaviest decay in top layers.
			22 cars 1-20%	Mostly slight decay.
Idaho	5	5	1-12%	Mostly slight decay.
Illinois	4	6	2-12%	Associated with blue mold.
Maryland	2	32	4-60%	Heavy decay in one load.
Michigan	1	2	2%	Slight decay.
Missouri	3	3	1-5%	Slight decay.
New York	2	2	2%	Slight decay.
Oklahoma	5	6	1-15%	Mostly slight decay.
Oregon	2	7	6-9%	Slight decay.
Texas	5	6	2-14%	Mostly slight decay.
Utah	63	9	3 cars 30-40%	Associated with brown rot.
			60 cars 1-25%	Mostly slight decay.
Washington	29	12	5 cars 32-50%	Heaviest decay in tops of loads.
West Virginia	1	42	10-75%	Accompanied by brown rot.
Unknown	1	17	15-20%	
Total	212		Number of cars inspected	1644

Powdery mildew caused by Sphaerotheca pannosa (Fr.) Lev.

Powdery mildew was reported from South Carolina (local), Texas (trace, unimportant), and Washington.

OTHER DISEASES

Rust, caused by Puccinia pruni-spinosae Pers., was reported from South Carolina (local); Florida (general, unimportant, occurring late); Alabama (general); and Texas (prevalent, unimportant).

Root knot, caused by Heterodera radicicola (Greef.) Mull., was reported from South Carolina and Texas. In the latter state it was not at all important but in South Carolina it was said to be common, affecting a large percentage, (perhaps 40%) of the peach trees all over the state.

Die-back caused by Valsa leucostoma Fr., was reported from Ohio (less); Indiana (rare); South Carolina (local); Oklahoma (one report); and Arkansas (very little this year associated with frost injury).

Frosty mildew caused by Cercosporella persicae Sacc., was reported from South Carolina as common.

Root rots caused by Armillaria mellea Vahl. and Clitocybe monadelpha were general and very severe in Arkansas, where Elliott estimated 1-2% of the trees injured. Many acres of trees were affected and according to Elliott the Clitocybe seemed to be more important than the Armillaria in causing the trouble. In southern Arkansas a great amount of damage was observed by Mr. J. A. Hughes, Horticulturist with the American Refrigerator Transit Co. His report is as follows:

> "Not long ago I visited a twenty acre tract of eight year old peach trees in central Arkansas. The trees are in thrifty condition and heavily loaded with fruit, but about thirty per cent of them are dead, while about thirty per cent show advanced stage of Armillaria. The soil is well drained and a friable clay loam, but the trees were planted on cut over land and the numerous large oak stumps have never been removed. Throughout the entire peach belt of the state wherever the trees have been planted on stumpy or undrained land, root rot plays havoc. The Garner orchard near Cabin Creek of some forty acres has less than fifty per cent of stand and many are still dying."

Armillaria root rot was also reported from Brown County, Indiana.
Leaf spot (non-parasitic) reported from Okanogan County, Washington.
Split pit reported from Walla Walla, Washington.
Water injury was reported from Arizona by J. G. Brown as follows:

> "A loss of about 5000 peach trees in the lower Salt River Valley due to water-logged condition of the soil, has just been reported (July 15). This is a very important matter in connection with irrigation. Its economic importance in a state where the orchard acreage is small is noteworthy."

Spray injury, caused by lime and sulphur with arsenate of lead, was reported from several different points in Connecticut. For some reason there seemed to be more of this than usual in that state.

Frost injury - Late frost at blossoming time in early May killed many blossoms in Connecticut, New York, Michigan, and other states. Frost injury

was also very srious in Washington. Clinton in Connecticut reported as follows:

> "Killed blossoms of some varieties more than others. Profusion of bloom, however, gave a fair set in most places. Champion buds winter-killed and failed to blossom, with resulting light crop."

Winter injury - The bad effects of the severe winter of 1917-18 were still evident in 1919. Trees in many orchards in the more northern peach states continued to die and many others remained in a dying or sickly condition. According to Clinton, probably one-half of the trees in Connecticut are now dead or worthless and little replanting is being done.

Not much winter injury took place in the east during the winter of 1918-19, but Idaho and Washington reported considerable damage. In Idaho 20% injury and 5% loss was estimated.

Cat face (non-parasitic) was present in shipments of peaches from Maryland, West Virginia, Texas, Oklahoma, and Arkansas according to market inspectors whose estimates are as follows:

Arkansas	- 3 cars with some cat face in each.
Maryland	- 1 car with 8%.
Oklahoma	- 1 car with 30% cat face and other blemishes.
Texas	- 4 cars with small percentage of cat face.
West Virginia	- 2 cars with trace to 4% cat face.

PLUM and PRUNE

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt.

Brown rot on plum was reported from practically all states east of the 100th meridian and from Washington and Oregon. Its range was about the same as the disease on peaches except that it occurred farther north on account of the more northerly range of the host.

The most common form of injury was fruit rot but complaints of twig blight were received from Illinois, Kentucky, Iowa, Minnesota, and Washington. Blossom blight was general in New York, and leaf injury was mentioned as occurring in Minnesota.

In general the percentages of loss ware highest in the states where brown rot of peach was the worst. Unlike the peach disease, however, it was serious in Michigan and Illinois. Table 46 summarrizes the data on losses as furnished by collaborators.

Apothecia were noted as very abundant at University Farm, St. Paul, Minnesota, early in the spring, and D. F. Fisher reported that, "Apothecia and rainy weather were very prevalent (in lower Willamette and Columbia Valleys of Oregon and Washington), hence conditions were favorable for infection."

Table 46. Injury from plum brown rot in 1919. (Collaborators' estimates.)

State	Percentage crop injured	State loss	State	Percentage crop injured	State loss
Arkansas	10	$5000	New York	-	Heavy
Delaware	-	10-15%	Pennsylvania	-	20-25%
Georgia	5-100	25%	South Carolina	60%	15%
Illinois	10	-	Texas	-	1%
Michigan	-	Heavy	Vermont	-	5-10%
Missouri	5-10	-			

The disease was noted in various states on different varieties as follows:

Agen (Petite Prune) - More severely affected than Italian Prune in the Williamette and Columbia River Valleys.
Arch Duke (reported as Late Duke) - Die-back of twigs 4 inches at Lexington, Kentucky.
Pond (Oswego) - Rotted badly in Connecticut.
Sugar - More severely affected than Italian Prune in the Williamette and Columbia River Valleys.
Yellow Egg - Loss of 100% in at least one case in Michigan.
Wild Plums - Reported affected in Minnesota.

Spraying gave only fair control where used in Michigan and South Carolina; and, according to D. F. Fishers, was not very effective on prunes in Washington and Oregon. Copper sprays are mentioned as giving good results in Ohio. Plums do not seem to be very generally sprayed, according to collaborators. Control of the curculio is very important in the prevention of rot.

Pockets caused by Exoascus pruni Fckl.

This disease was reported in 1919 from Ohio, Indiana (twig injury in one orchard), Minnesota, Iowa (rather common), Missouri (occasional), Arkansas (on wild plums), North Dakota, Nebraska, Colorado (general, moderate loss), and California. A local occurrence was also noted in South Carolina.

In California the disease was very destructive in the Sebastopol region last year, where the crop in some orchards was a total loss. Prior to 1919 the disease had been comparatively rare in that region. In Minnesota plum pockets were more prevalent than usual, probably injuring about 2% of the fruit. The Section of Plant Pathology of the Experiment Station in that state reported, "Disease very inconsistent in appearance from year to year. It has not appeared this year in places where it was abundant in 1918. The Surprise, grown quite extensively here, is susceptible. Both lime sulphur and Bordeaux inconclusive."

Black knot caused by Plowrightia morbosa (Schw.) Sacc.

Reports of the occurrence of black knot on plum were received from Connecticut, New York, New Jersey (common), Pennsylvania (prevalent), Delaware (common), West Virginia, Ohio, Kentucky, Indiana, Wisconsin, Minnesota, North Dakota, and Arkansas (on wild plum). It seemed to be maintaining itself in about the average amounts, although in Ohio it caused more trouble than usual. In that state it was said to be especially prevalent in the southern part on damson varieties.

Leaf blight caused by Coccomyces prunophorae Higgins.

This leaf disease was reported from New York, Ohio, Michigan, Minnesota (less than 1% loss), Nebraska, and South Carolina (2% loss).

Black spot caused by Bacterium pruni E. F. S.

Black spot on the plum was reported from Indiana (general), Illinois, Missouri, Arkansas (common), Kansas, Oklahoma (quite common), and Texas (prevalent). In Illinois it caused considerable loss of foliage and produced many twig cankers which seriously weakened the trees.

Other diseases.

Crown gall caused by Bacterium tumefaciens Sm. and Towns. was reported only from Florida and Washington in 1919.

Scab caused by Cladosporium carpophilum Thum. seemed to be rather common in southern Missouri. It was also collected in Minnesota on Prunus americana.

Wilt, thought to be caused by Lasiodiplodia triflorae Higgins, was reported by collaborator Berry as general in Georgia, causing an estimated loss of 15% for the state.

Powdery mildew caused by Podosphaera oxyacanthae (Fries.) De Bary was collected in New Mexico in June.

Die-back caused by Valsa leucostoma was reported from Ohio (less), and Colorado (general, slight loss).

Rust caused by Puccinia pruni-spinosae Pers. was collected in Logan and Payne Counties, Oklahoma.

Heart rot caused by Fomes fraxinophilus was reported by D. F. Fisher from Salem, Oregon as follows: "I have found several orchards (prunes) severely affected, the Petite variety more often than the Italian. In some cases every tree is affected and they break under slight strain.

Silver leaf. Leaves showing typical symptoms of this disease were sent to the Michigan Agricultural Experiment Station from Allegan County, Michigan.

Leaf curl, cause uncertain but probably Taphrina, was sent to the Wisconsin Agricultural Experiment Station from Waupaca County, Wisconsin, May 27.

Yellows (cause unknown). Small yellow leaves borne on spindling shoots were observed on Japanese plums in Delaware County, Pennsylvania, September 22.

Chlorosis (non-parasitic). Reported from New Mexico.

Gummosis (cause undetermined) was observed locally in New Mexico. The four trees that were affected died.

Drought spot (insufficient moisture) was reported from Idaho (very serious, causing dropping of fruit before mature), and Washington.

Frost injury. Reported from Washington.

Winter injury. Reported from Washington.

Drop (cause unknown) caused about 10% loss of prunes in Erie County, Pennsylvania.

Fire blight caused by Bacillus amylovorus(Burr.) Trevisan was reported by Coons as destroying 25% of the trees in one orchard in Michigan.

CHERRY

Leaf spot caused by Coccomyces hiemalis Higgins.

Taking the country as a whole, leaf spot was probably much more severe than usual. At least it was more abundant than in 1918. It was reported from Pennsylvania (more), New Jersey (abundant), Delaware (general), Maryland (unusually bad), Virginia (especially severe), West Virginia, South Carolina (common), Georgia (general), Ohio, Tennessee (general), Indiana (very general), Illinois (unsually abundant), Michigan (bad in unsprayed orchards), Wisconsin, Minnesota (on wild plum), Iowa (common), Missouri (general), Arkansas (general and severe), Kansas (local), Idaho (rare), Washington, and California (quite prevalent in Sonoma County).

M. B. Waite, Office of Fruit Disease Investigations, has furnished the following on the occurrence in Maryland and Virginia:

> "This was unusually bad in both Maryland and Virginia this year on both sweet and sour cherry trees, but sweet cherries were not generally so badly attacked as sour varieties. Sour cherries were usually unsprayed, and in many cases, the fruit was reduced in size and rendered almost worthless in quality for marketing. The damage probably exceeded 60% on unsprayed sour cherries in Montgomery County, Maryland, and similar observations were made in Fairfax County, Virginia. Some little spraying was done on sour cherries, and it appeared to be fairly effective against this disease."

Collaborators' estimates of state losses were as follows: Pennsylvania 75% foliage, 3-4% fruit; Delaware - 10% leaves injured; South Carolina - 2% loss; Georgia - 2-3% loss; Indiana - 90% injury; Wisconsin - trace loss; Iowa - 2% injury; 100% locally; Arkansas - 10% injury. In many Michigan orchards the leaves dropped and the cherries developed only to about the size of peas.

Twenty-seven varieties growing at Urbana, Illinois, showed no great differences in relative susceptibility, according to H. W. Anderson.

Spraying seems to be quite successful against this disease. Bordeaux was reported satisfactory in Indiana (2-4-50), and Arkansas.

Brown rot caused by Sclerotinia cinerea (Bon) Schröt.

The range of brown rot on cherry was about the same as on peach and plum. It was reported from most of the cherry producing states in the eastern half of the country and on the Pacific Coast. It was by far the most severe in states along the Atlantic Coast from Georgia northward. Thus, Delaware reported 20% loss; Pennyslvania 10%; New Jersey, very destructive; Virginia, very severe locally; South Carolina, common, 25% injury; and Georgia general, heavy loss. In the states farther west not so much brown rot occurred although it was common and locally destructive in the Mississippi Valley region. West of the 100th meridian the disease did no damage except on the Pacific Coast. In western Washington it was common, causing moderate losses. From the lower Williamette and Columbia Valleys of Oregon and Washington, D. F. Fisher reported that the yield of cherries was often reduced 50% because of the blossom blight form of the disease. He further stated that the loss seemed to be greatest when cherries were in proximity to prune orchards, and that apothecia were found abundantly during the rainy weather of early spring.

The following cherries were reported very susceptible: Oxheart in Indiana, White Oxheart in Pennsylvania, and Queen Anne in Virginia.

The disease was also reported on wild cherries in Washington and South Carolina.

Black knot caused by Plowrightia morbosa (Schw.) Sacc.

Black knot on cultivated cherry was reported from Delaware, Pennsylvania, West Virginia, South Carolina, and Ohio.

It was reported on wild cherry from South Carolina, Minnesota (on Prunus pennsylvanica, P. serotina, and P. virginianae), and Arkansas. This disease probably shows marked differences in the degree to which it affects various varieties of Prunus. An accumulation of more careful notes on varietal susceptibility to black knot should show some interesting and perhaps valuable things. It is hoped that collaborators and others will pay more attention to this phase of the subject during the coming seasons.

Powdery mildew caused by Podosphaera oxyacanthae (Fries) De Bary.

Reported from Pennsylvania (trace, Erie County, August 16); South Carolina (common); Ohio (more); Indiana (local, no loss); Illinois (common); Iowa (very common); Missouri (common); Nebraska, Kansas, and Washington. It was mentioned in a number of states that it was especially common on young shoots, such as suckers and nursery stock.

Other diseases.

Witches broom caused by Exoascus cerasi (Fckl.) Sadeb. - reported from western Washington.

Root rot caused by Clytocybe sp. and Armillaria sp. - trace reported from Arkansas.

Bacterial gummosis caused by Bacterium cerasi Griffin was reported from Washington, and what was thought to be the same was observed in Missouri and Oklahoma.

Gummosis (non-parasitic) was reported by Heald from Washington, and a gummosis of some kind was rather general in Erie County, Pennsylvania, last year.

Silver leaf, said to be caused by Stereum purpureum, was reported by the Section of Plant Pathology as killing one tree on the University Farm at St. Paul, Minnesota.

Die-back caused by Valsa leucostoma Fr. var cincta Rolfs. - Reported from Ohio.

Sap rot caused by Schizophylum commune - Reported from Ohio.

Shot hole caused by Cercospora circumscissa - Reported from Ohio.

Frost injury was much greater than usual in Washington.

Winter injury - Reported from Ohio (much loss), and Washington.

Niter injury caused by excess of nitrates in soil, was reported from Colorado as abundant, causing 10% loss.

APRICOT

Brown rot caused by Sclerotinia cinerea (Bon.) Schröt. was reported from Oklahoma and western Washington.

Scab caused by Cladosporium carpophilum Thüm. was observed in Oklahoma (three occurrences noted), Texas (unimportant), and New Mexico (slight injury).

Coryneum blight caused by Coryneum beijerinckii Oudem. was reported from Idaho and both the eastern and western parts of Washington. Of course, it also occurred in the other Pacific Coast states, but no reports are at hand.

Leaf spots, causes not clear, were observed in Missouri and Texas.

A fruit spot of uncertain cause was reported by Heald and Dana from Washington.

Water injury was reported by J. G. Brown of Arizona as follows: "A loss of about 5000 trees in the lower Salt River Valley due to water-logged condition of the soil, has just been reported. This is a very important matter in connection with irrigation. Its economic importance in a state where the orchard acreage is small, is noteworthy."

ALMOND

Scab caused by Cladosporium carpophilum Thüm. was abundant on the twigs in parts of Mississippi, April 18-26.

Kernel mold caused by Penicillium sp. was reported from Klickitat County, Washington.

DISEASES OF SMALL FRUITS

GRAPE

Black rot caused by Guignardia bidwellii (Ellis) V. & R.

This, the most serious disease of the grape, occurred widely over the entire eastern portion of the United States. It was most serious in the southern two-thirds of the country, where warm weather prevailed and where spraying is not generally practiced, and also along the Atlantic Coast where the disease was favored further by abundant moisture. It was mentioned as being considerably worse than usual in the majority of the Coast states. In the commercial areas of New York, Michigan, and northern Ohio, however, where systematic spraying with Bordeaux is practiced, the disease was satisfactorily held in check and an excellent crop of grapes was produced. The extensive vinyards of California do not seem to suffer from black rot.

The extent of the losses is indicated by the following estimates of collaborators:

Connecticut - 10% injury, Pennsylvania - 10% loss, Delaware - 25% injury, West Virginia - 10% loss, South Carolina - 25% loss, Georgia - 10% loss, Florida - 5-50% foliage affected, Alabama - 10% loss, Louisiana - 5-20%, Texas - 5% loss, Arkansas - 5% injury, Kentucky - 5% injury, Illinois - 1/2% loss, Iowa - trace loss, Missouri - 2-50% loss in individual cases. Losses of 75-100% were reported by two growers in Connecticut, and 20, 15, and 25% reduction in yield was observed in three localities in Louisiana. One-half the crop was lost in a one-half acre vineyard in Cape Girardeau County, Missouri; and 30-50% reduction in yield was recorded for York, Huntingdon, and Wyoming Counties, Pennsylvania. In Michigan it was present in some neglected vineyards, causing losses of not over 10%, but the commercial orchards were largely free.

The following dates of first appearance were given by collaborators:

May 7 .....Florida	June 21 .....Delaware
May 30.....Georgia	June 27 .....Indiana
May 30.....South Carolina	June 27 .....Missouri
June .....Arkansas	July 17 .....Pennsylvania
June 21.....Alabama	August 20.....Connecticut

Muscadine grapes were said not to be affected in Georgia, and Concords were mentioned as rotting badly in a number of states.

In general, spraying with Bordeaux was said to give satisfactory results when the fungicide was properly applied. In Delaware, however, many growers claimed to be unable to control black rot with the ordinary grape spraying beams with 4-5 nozzles per row. The Station, therefore, recommended that the spray be directed by hand to the clusters, using two leads of hose with a group of 2-3 nozzles on each.

Downy mildew caused by Plasmopara viticola (B. & C.) Berl. and de T oni.

Downy mildew was more prevalent than in 1919 when it occurred in subnormal amounts. It was reported from Vermont (scarce), Connecticut (more than average), New Jersey (common, not serious), Pennsylvania (more than 1918), South Carolina (common), Louisiana (slight), Texas (trace), Ohio, Kentucky (1% loss at Experiment Station), Illinois (very abundant, 1-2% injury, 1% loss), Minnesota, and Iowa (common).

Powdery mildew caused by Uncinula necator (Schw.) Burr.

Reported from Connecticut (probably average amount), South Carolina (local), Iowa (trace), Missouri (uncommon), Arkansas (common, trace injury).

Anthracnose caused by Gloeosporium ampelophagum Sacc.

Reported from Delaware, Ohio, West Virginia, Mississippi, and Arkansas. According to Manns and LeCato, June 30, the disease caused 50% loss of a heavy set of Concord grapes near Dover, Delaware, while Moore's Early was only about 25% affected.

Other diseases.

Crown gall caused by Bacterium tumefaciens Sm. & Towns. was reported from Delaware (common, 1% injury), Ohio, and New Mexico. It occurs commonly in the vineyards of the Pacific Coast, especially in Oregon and Washington, and apparently varies but little from season to season.

Dead arm caused by Cryptosporella viticola (Reddick) Shear was reported from New Jersey (rare), Pennsylvania (probably less than 1918), Virginia, Ohio (few scattered cases), and Michigan (vineyards sometimes decimated but new growth all right).

Ripe rot, caused by Glomerella cingulata (Stoneman) Sp. & von S., was reported from Delaware as very common and severe, apparently causing large losses, but which, on account of complications with black rot and anthracnose, were very difficult to estimate.

White rot caused by Coniothyrium diplodiella (Speg.) Sacc. was reported to be very severe in the southern part of Illinois, where 1-2% injury occurred, according to H. W. Anderson.

Root rot caused by Ozonium omnivorum Shear was prevalent on heavy lands in Texas according to J. J. Taubenhaus.

A leaf spot thought to be caused by Cercospora viticola was collected in two localities in Ohio.

Lightning killed 3 rows of grapes, each 400 yards long, two miles from Dover in Kent County, Delaware, according to J. M. LeCato, June 28.

STRAWBERRY

Leaf spot caused by Mycosphaerella fragariae (Schw.) Lindau.

In 1919 leaf spot occurred practically everywhere the strawberry was grown. It was reported from the majority of states and for the most part was generally distributed and present in about the average amounts. In Florida and Georgia, however, it was thought to be somewhat less abundant than usual.

In general the percentage of plants injured was rather high, but the actual loss slight. Six states gave estimates of percentage of crop injury as follows: Vermont 10-15%, Delaware 5%, Georgia 5-75%, Minnesota less than 1%, Arkansas 25%, and Colorado 10%. The dates when the disease was first called to the attention of collaborators were:

April 18	Mississippi	June	Oklahoma
May	Arkansas	June	Wisconsin
May 10.....	Georgia	June 1.....	Vermont
May 24.....	Minnesota	June 17.....	Ohio
May 27.....	Indiana	June 20.....	Pennsylvania
May 29.....	Washington	August 5.....	Colorado

There seem to be rather marked differences in varietal susceptibility to this disease. In Minnesota, where varietal differences were noted, the disease was said to be severe on the cultivated varieties Superb and Dunlap, and on wild plants. In Illinois the Belt (William Belt) was very susceptible according to H. W. Anderson, and in Texas L. R. Hesler found it to be more abundant on Klondike than on Lady Corneille.

Gray mold rot caused by Botrytis sp.

Gray mold rot was reported in the field only from Connecticut (probably less than usual), Michigan, Wisconsin (trace, where planting was too thick), Minnesota (local), and Louisiana.

Inspectors of the Bureau of Markets examined 81 cars of strawberries from various states and found more or less gray mold rot in 37 of them as follows:

Table 47. Percentages of gray mold rot in shipments of strawberries as found by market inspectors, 1919.

Origin of shipment	No. cars with decay	Average percentage of decay	Origin of shipment	No. cars with decay	Average percentage of decay
Alabama	1	1	Missouri	4	10
Arkansas	8	25	North Carolina	2	15
Delaware	1	t	Ohio	1	--
Kentucky	6	34	Tennessee	7	14
Louisiana	3	20	Wisconsin	1	35
Michigan	2	12	Unknown	1	45

Rhizopus rot caused by Rhizopus nigricans.

This disease was reported by collaborators as being present in the field in Pennsylvania, Mississippi, Louisiana, Texas, Iowa, Nebraska, and Kansas. R. B. Wilcox reported finding it in Ohio but apparently it was only on berries previously injured mechanically. In Iowa the disease was said to be common and severe, and in Kansas it seemed to be the cause of considerable loss as is indicated by the following report of L. E. Melchers:

> "The past season the Rhizopus disease was causing serious injury on immature strawberries. The fruit was attacked and decayed when unripe and before it was ready for picking. It was noticed that wherever the berries touched the ground the disease was serious. Mulching with straw undoubtedly will prevent some of this. Especially on Senator Dunlap and Progressive."

The rot was common in the markets as usual. The following table gives one an idea of the losses it may cause to berries in transit.

Table 48. Percentages of Rhizopus rot in carload lots as found by market inspectors, 1919.

Origin of shipment	No. of cars with rot	Percentages of Rhizopus rot	Place where inspected.
Alabama	2	5-50 in each car	Cincinnati.
Arkansas	6	15,10,17,15,15,15	Des Moines, Detroit, and St. Louis.
Delaware	1	50-55	Cleveland.
Kentucky	3	60-80, 20,20	Chicago and Detroit.
Louisiana	3	10, 40, slight	Kansas City, Detroit.
Maryland	1	25	Pittsburgh.
Michigan	1	30-40	Chicago.
Missouri	2	20-25, 15	Chicago and Indianapolis.
North Carolina	1	8	Philadelphia.
Ohio	2	50,15	Detroit and Cleveland.
Tennessee	3	40,50, some	Chicago and Cincinnati.
Wisconsin	1	35	Milwaukee.

Total cars with Rhizopus rot..... 26
Total cars strawberries inspected 81

Other diseases.

Powdery mildew caused by Sphaerotheca humuli (De C.) Burr. was reported from New Jersey, Nebraska, and Texas.

Nematode - Tylenchus dipsaci (Kühn) Bastian was found at Corvallis, Oregon. (See Byars, L. P., Phytopath. 10: 91-95, 1920).

Leaf blight caused by Phoma obscurans E. & E. was reported by H. W. Anderson as abundant in Illinois, occurring throughout the year. He states that the disease has been confused with the ordinary leaf spot (Mycosphaerella fragariae). The Dunlap variety was quite susceptible in Illinois.

Leaf blotch caused by Ascochyta fragariae was reported from Connecticut where it was about as usual. According to G. P. Clinton this probably did more damage than the Mycosphaerella leaf spot especially on the variety Glen Mary, which, according to him, is very susceptible.

Crown rot, probably due to Rhizoctonia, occurred in Idaho, and undetermined root rots were reported from Alabama (apparently of some importance in some localities), and Wisconsin (local, trace of injury).

Fruit rot, thought to be caused by Rhizoctonia on berries resting on soil occurred in parts of Washington. Some injury to the vines was also reported.

A slime mold did some damage to crop in Nebraska during wet weather.

Drought injury - Connecticut.

Winter injury - Connecticut, New Jersey.

Frost injury - Washington (crop reduced nearly one-half).

RASPBERRY

Anthracnose caused by Plectodiscella veneta Burkholder.

Anthracnose undoubtedly occurred much more widely than is indicated by the reports that were received. These were from the following states: New Jersey, Pennsylvania, West Virginia, Ohio, Indiana, Illinois, Wisconsin, Minnesota, Missouri, Arkansas, Oklahoma, and Washington. In most of these states, particularly those in the central part of the country, the disease was general and the cause of some loss. Regarding the disease in Ohio, R. B. Wilcox, Office of Fruit Disease Investigations has given the following report:

> "Anthracnose was common in nearly all fields, especially on black raspberries of all varieties. Damage hard to estimate. During 1919 the crop was reduced considerably by dry weather during the picking season, and the effect of the drought was much increased by the occurrence of numerous anthracnose spots on the canes. A more tangible effect was the killing and weakening of many tips and buds on young growth late in the season, which will reduce the crop of 1920. Reduction of 1919 crop, probably at least 10%."

The injury in West Virginia was estimated as 10%, in Illinois 1-3%, Missouri 50%, and Arkansas 10%, while the actual loss of black raspberries in Wisconsin was placed at 2-5%.

Black raspberries were much more severely attacked than red varieties. The Sunbeam, Minnesota, and King in Minnesota; the Turner in Wisconsin; and the Cumberland, Kansas Black, and Cardinal in Missouri, are reported susceptible. King and Miller are reported as among the least affected in Wisconsin.

In Wisconsin one grower claimed good results with a dormant spray of lime sulphur 1-20.

Spur blight caused by Mycosphaerella rubina (Pk.) Jacz.

This disease was reported from Connecticut, (probably usual amount), Illinois (abundant on all red varieties observed), Ohio (general), Wisconsin (trace on blacks, general and slight on reds), and Washington (Pierce and Thurston Counties).

R. B. Wilcox of the Office of Fruit Disease Investigations, reported for Ohio as follows:

> "Spur blight occurred generally on both red and black varieties, most abundantly on the former, though apparently not doing much damage there. Considerable damage to some fields of blacks, especially of the Kansas variety, though mostly in the way of killing buds and spurs, thus reducing the 1920 crop. Average damage very small."

In Minnesota it was found on wild as well as cultivated raspberries. The following varieties are listed as susceptible in that state: Turner, Sunbean, Minnesota, King. In one case Cuthbert and Louden were not attacked, while King, in the same row with them, was affected. In Wisconsin R. E. Vaughan reported Marlboro as least affected of the red varieties.

Cane blight caused by Leptosphaeria coniothyrium (Fckl.) Sacc.

Cane blight occurred on red and black raspberries in New Jersey, Delaware, West Virginia, Ohio, Indiana, Illinois, Wisconsin, Arkansas, and Idaho. As a whole it did not do much if any damage, although 10% injury in Delaware, 5% in Arkansas, and 1% or less in West Virginia was reported.

Yellows (cause unknown).

Yellows was reported from Connecticut (one report), Pennsylvania, Ohio, Indiana (rare), Wisconsin (scattered on black, and general on red raspberries), Minnesota (probably very general), and Colorado (slight). In Pennsylvania as high as 50% of the crop was injured more or less in two counties. Collaborator C. R. Orton reported the disease to be present in most of the old red raspberry patches, but usually not recognized by the owners.

In Ohio R. B. Wilcox reported, "Common on all red varieties noted, and found occurring in a few fields of blackcaps of the Cumberland variety. Injury to blacks negligible; to reds probably 10%."

Cuthbert was reported susceptible in Pennsylvania.

Leaf spot caused by Septoria rubi Westd.

This disease was of slight importance according to the reports from Connecticut, New Jersey, Ohio, Wisconsin, Minnesota, Missouri, and Oklahoma.

Orange rusts caused by Gymnoconia interstitialis (Schlecht.) Lagerh. and Kunkelia nitens.

This was reported to the survey as follows: Connecticut (I stage, long cycle, about as usual), Indiana (very prevalent early in season), Illinois (occasionally observed), Wisconsin, Minnesota, Nebraska, Oklahoma (Early Harvest least susceptible, McDonald most), Iowa (common, one plantation plowed up because of rust), and Washington.

Other diseases.

Crown gall caused by Bacterium tumifaciens Sm. & Towns. was common on raspberries. It was reported from New Jersey, Delaware, Ohio, Illinois, and Wisconsin. Injury of 10-12% was estimated in Delaware, 2-5% in Illinois, and in Wisconsin it was considered one of the important diseases. R. B. Wilcox reported from Ohio:

> "Very common, though severe in only a few plantations. Especially destructive to reds. Damage impossible to estimate; possibly 5% on reds, 1% on blacks; these figures can only be guesses. Per cent of infection, of course, much higher than this."

The variety Turner was said to be most and the St. Regis least resistant in Wisconsin.

Rust reported as caused by Phragmidium imitans was collected in Washington.

Powdery mildew caused by Sphaerotheca sp. was observed in Ohio and Minnesota.

Fruit rot caused by Botrytis sp. was reported from Minnesota and Washington.

Sun scald caused by intense sunlight was rather general in parts of Colorado, causing slight injury.

BLACKBERRY, DEWBERRY, AND LOGANBERRY

Orange rusts caused by Gymnoconia interstitialis (Schlecht.) Lagerh. and Kunkelia nitens.

In 1919 one or the other of these rusts were reported from practically all states in the eastern half of the country (east of the 95th merician), and from Washington. Most of these states indicated that rust was very common,

especially on wild blackberries. Susceptible, cultivated varieties were also severely affected in some places. In parts of Ohio, R. B. Wilcox reported as high as 10% infection in some fields, while it was absent in others.

The dates when the first reports of rust were received were given by collaborators as follows:

April - Arkansas	May 27 - Pennsylvania
May - South Carolina	May 28 - Indiana
May - Georgia	June 9 - Minnesota
May 10 - Illinois	June 12 - Ohio
May 12 - Washington	June 15 - New Hampshire
May 19 - Missouri	

In the District of Columbia the disease appeared on the first young leaves of wild blackberries shortly after they emerged from the buds.

Notes on the resistance of varieties to rust were furnished by two collaborators as follows;

Georgia: "Few cultivated berries in Georgia. Perhaps more would be grown if rust was not so serious. Am testing some resistant dewberries with good results." McClintock.

Illinois: "In a patch at Urbana, LaGrange, and Snyder were planted side by side. The LaGrange rusted so badly that they had to be dug out, while the Snyders were entirely free from the disease. La Grange is not regarded as being as susceptible as Early Harvest." H. W. Anderson.

Leaf spot caused by Septoria rubi Westd.

This spot was reported from New Jersey, Pennsylvania, Ohio, Wisconsin, Minnesota, Iowa, Missouri, Mississippi, Texas, Washington, and California. In general it was unimportant, but in California the combination of this disease and weather conditions has caused considerable damage to blackberries, raspberries, and loganberries during the last two seasons.

Anthracnose caused by Plectodiscella veneta Burkholder.

On blackberry this disease was reported from New Jersey (also on dewberry), Delaware, Ohio, Wisconsin, Illinois, Missouri, Kansas, and Washington. It was common in the first four of these states, but seemed to be of economic importance in Delaware, where it was severe in some sections.

Other diseases.

Crown gall caused by Bacterium tumefaciens Sm. & Townes. was reported from Ohio (occasional), Texas, Wisconsin, Minnesota, and Washington. It was reported important only in Wisconsin, where it was said to be the limiting factor in production in the largest blackberry section.

Powdery mildew caused by Sphaerotheca humuli (De C.) Burr. was reported by R. B. Wilcox, Office of Fruit Disease Investigations from Cuyahoga, Loraine, and Lake Counties, Ohio as follows: "Very prevalent late in summer. Great differences in severity on different varieties, the Taylor, Ward, and Blowers being worst, in the order named, while Wilson and Snyder were rather resistant. Eldorado (most commonly grown) moderately affected. Little damage."

The disease was also reported from Minnesota.

Double blossom caused by Fusarium rubi Winter - common in New Jersey, Delaware, Mississippi, and Louisiana. In the two latter states it was noticed in April, especially on wild plants.

Cane blight caused by Leptosphaeria coniothyrium (Fckl.) Sacc. - reported from Ohio and Wisconsin (one occurrence in Monroe County).

Spur blight caused by Mycosphaerella rubina (Pk.) Jacz. was collected in one place in Outagamie County, Wisconsin.

Leaf blight, thought to be of bacterial nature, was reported from Pierce County, Washington.

CURRANT

Leaf spot caused by Mycosphaerella grossulariae (Fr.) Lind. occurred in Pennsylvania, New Jersey, Ohio, Minnesota, Iowa, and Missouri. It also doubtless occurred in many other states although these were the only ones from which it was reported. In years prior to 1919 reports were received from the additional states of Maine, Vermont, Massachusetts, New York, Delaware, Maryland, Indiana, Michigan, Wisconsin, Iowa, South Dakota, Arkansas, and Washington.

Anthracnose caused by Pseudopeziza ribis Klebahn was reported only from Minnesota, where it was collected on Ribes aureum, R. vulgare, and R. americanum.

Blister rust caused by Cronartium ribicola Fisch. von Waldh. - Reported by collaborators in New Hampshire, Vermont, (wide spread), Connecticut (on several species of Ribes), New Jersey (two species of Ribes), and Minnesota.

Cane blight caused by Botryosphaeria ribis Grossenbacher and Duggar was common and destructive in parts of New Jersey and very destructive in Cuyahoga Couty, Ohio, on some plantations.

Angular leaf spot caused by Cercospora angulata Winter - Reported as common in Iowa, causing defoliation in cases.

Cane blight caused by Nectria sp. was reported from Minnesota, North Dakota, and New Mexico.

Die-back caused by Botrytis sp. reported from Washington and California.

Rusts. Miscellaneous rusts were collected on Ribes in Minnesota and Connecticut. In the later state G. P. Clinton reported the collection of Aecidium grossulariae on black currant for the first time on that host. It occurred on both leaves and fruit.

Gloeosporium ribis (Lib.) M. & D. was reported very common in New Jersey.

GOOSEBERRY

Powdery mildew caused by Sphaerotheca mors-uvae (Schw.) B. & C. - Reported from Missouri, Iowa (on wild gooseberry), Colorado (slight), Idaho (fairly common; about 5% loss), and Washington.

Leaf spot caused by Mycosphaerella grossulariae (Fr.) Lind. - Reported from New Jersey (common), Ohio (less), Minnesota, and Missouri.

Anthracnose caused by Pseudopeziza ribis Klebahn was reported from New Jersey (common), Minnesota, and Washington.

Blister rust caused by Cronartium ribicola Fisch. von Waldh. - Reported widespread in Vermont (see also currant page 170 and pine in later report).

Rusts of various kinds were reported from Ohio, Minnesota, Iowa, and North Dakota.

Die-back caused by Botrytis sp. was reported from Pierce County, Washington.

Sun scald of fruit on bushes was rather general in Cuyahoga County, Ohio, according to R. B. Wilcox. In some plantations nearly all fruit on bushes was ruined during the hot weather of July 3-4.

CRANBERRY

C. L. Shear, Bureau of Plant Industry, has kindly furnished the following report on the cranberry disease situation in 1919:

> "The season of 1919, while not showing any unusual amount of disease and rot in the field, showed much more rot and spoilage during distribution and marketing. This was true not only of the fruit from New Jersey, Massachusetts, and Wisconsin, but also from the Pacific Coast. Just what the cause was, is uncertain. It may have been due to unusually favorable climatic conditions for the development of rot after picking or to the unusual amount of infection of fruit during the growing seacon.
>
> "Early rot casued by Guignardia vaccinii, bitter rot caused Glomerella cingulata vaccinii, end rot caused by Fusicoccum putrefaciens, and ripe rot by Sporonema oxycocci were very prevalent in eastern berries. On the Pacific Coast the most important rot occurring in our examinations of fruit seemed to be end rot.
>
> "The red leaf spot caused by Exobasisium vaccinii, Sclerotinia, and a black spot disease caused by an unnamed organism, were prevalent in some particular bogs rather seriously."

The actual percentages of decay found in carload shipments of cranberries by market inspectors is shown in the following table.

Table 49. Losses of cranberries from decay as shown by inspection of cars at destination, 1919.

Origin of shipment	No. of cars with decay	Average percentage of decay	Range of percentage of decay
Massachusetts	19	18	5 cars 28-48 14 cars 5-22
New Jersey	5	8	7-10
New York	1	17	17
Pennsylvania	1	7	7
Wisconsin	1	4	4
Total.....	27	Number of cars inspected - 37	

MULBERRY

A bacterial blight, possibly caused by Bacillus mori, was reported from Erie County, Pennsylvania, by J. H. Muncie, and from Madison County, Indiana, by M. W. Gardner.

Root rot caused by Ozonium onmivorum Shear occurred on mulberry in Texas according to Taubenhaus.

A blight of unknown cause was reported from Fulton County, Ohio.

DISEASES OF SUB-TROPICAL FRUITS

CITRUS

Scab caused by Cladosporium citri Massee.

Scab was reported from Florida and Porto Rico. In Florida, where there was more scab than during the previous season, it was generally distributed, causing losses to grapefruit as high as 50% in local instances. Nine cars of Florida grapefruit inspected at Boston November 15-28, 1919, were reported by market inspectors as showing the following percentages of scab: 15-20, 15-20, 10, 10, 8, 8-10, 12, 20, and 20.

Scab in Porto Rico was said to be on the increase causing varying amounts of loss.

Melanose caused by Phomopsis citri Fawcett.

According to H. E. Stevens this disease was generally distributed in Florida citrus groves and was more abundant than usual because of the wet summer. In some instances from 1-50% of the fruit was injured. The disease merely disfigured the fruit so that the loss consisted chiefly in a reduced selling price. Considerable loss was sustained, however, by this fungus

Table 50. Stem end rot of citrus caused by Phomopsis citri and Diplodia sp. as found by market inspection of carload shipments from Florida in 1919.

Grapefruit			Orange		
Place of inspection	Date	Per cent rot	Place of inspection	Date	Per cent rot
Buffalo	Jan. 11-13	2			
		4			
		9	Pittsburgh	Jan. 6	18
Houston	" 29	4	Boston	" 21	15
Buffalo	Feb. 5	t	New York	" 28	t
	5	t	Boston	" 29	6
Cleveland	Mar. 15	2	Houston	" 29	13
Fort Worth	" 19	3	Pittsburgh	Mar. 12	4
Detroit	Apr. 24	3	Chicago	" 22	45
Chicago	Oct. 1	8	Jacksonville	" 26	25
Dallas	" 9	5	New Orleans	Oct. 20	11
Minneapolis	" 28	16	Milwaukee	" 24	8
	" 29	24	Cincinnati	" 29	8
Detroit	Nov. 3	15	Pittsburgh	Nov. 1	6
Chicago	" 5	2	Chicago	" 1	10
	" 6	2	Atlanta	" 5	3
	" 11	17		" 6	12
Kansas City	" 8	5	Boston	" 12	6
Minneapolis	" 8	8	Baltimore	" 13	25
Boston	" 24	3		" 15	35
Chicago	" 17-18	13	Buffalo	" 17	5
Cleveland	" 17-18	10	Chicago	" 20	48
Denver	" 17-18	6	Pittsburgh	Dec. 4	10
Minneapolis	" 17-18	7	Buffalo	" 9	33
Pittsburgh	" 19	3	Pittsburgh	" 11	3
Dallas)	" 20-21	10		" 12	10
Denver)	"	8	Chicago	" 19	7
St. Paul)	"	7	Fort Worth	" 24	6
		4	Cincinnati	" 23	9
		3	Columbus	" 23	2
		2	Washington	" 31	2
Cincinnati	Dec. 8	4			
Indianapolis	" 11	4			
Boston	" 30	10			
Total No. cars - 34		6.6 (Av.)	Total No. cars - 29		13.3(Av.

(Phomopsis citri) causing stem end rot of citrus fruits both in the orchard and during transportation and marketing. Stevens reported this phase of the disease about as usual in the field. Local instances were noted where 5-50% of the fruit was attacked. Stem end rot caused by this fungus and by Diplodia was found in shipments from Florida, Porto Rico, and Cuba. The percentages in Florida shipments are given in Table 50.

Wither tip and anthracnose caused by Colletotrichum gloeosporioides Penz.

Wither tip and anthracnose were reported by H. E. Stevens as occurring about as usual in Florida. The disease of the fruit was found by market inspectors as shown in the accompanying table.

Table 51. Anthracnose of citrus fruits found in commercial shipments, 1919.

Fruit	Origin of shipment	No. cars	Place of inspection	Per cent anthracnose
Grapefruit	Florida	3	Buffalo	Trace in all cars.
		1	Jacksonville	8% in 2 boxes, 28% in remainder.
Lemon	Italy	1	Jacksonville	6% affected fruit of which 10% was a loss.
Orange	Florida	1	Jacksonville	About 1%.
	California	1	New York	18-20% fruit infected with 2-8 spots on each.
	Unknown	1	Chicago	15% affected. Spots one inch to one-third the surface in size.

Blue mold rot caused by Penicillium sp.

This disease probably caused more loss of citrus fruits, particularly lemons, than any other rot affecting the fruit during the process of marketing. Figures obtained from the market inspectors' certificates of inspection indicate that about one out of every ten lemons they examined were affected with this rot, that about six out of every hundred oranges and three out of every hundred grapefruit were likewise affected with blue mold.

Table 52. Blue mold rot in shipments of citrus as determined by inspectors of the Bureau of Markets, 1919.

Source	Orange		Grapefruit		Lemon	
	No. cars with rot	% rot	No. cars with rot	% rot	No. cars with rot	% rot
Arizona	2	10	-	-	-	-
California	153	8	5	23	61	13
Florida	101	14	58	8	-	-
Texas	-	-	1	6	-	-
Cuba	-	-	1	5	-	-
Italy	-	-	-	-	5	17
Unknown	3	4	-	-	-	-
Total	259		65		66	
Average % rot in cars with decay		10.7		8.9		13.4
Total no. cars inspected	449		155		87	
Average % rot in all cars inspected		6.2		3.7		10.2

Other diseases

Scaly bark caused by Cladosporium herbarum var. citricolum Fawcett, occurred in slight amounts as usual in Florida. It was localized and confined chiefly to Volusia, Brevard, Osceola, Polk, De Soto, Manatee, Pinellas, and Hillsboro Counties.

Foot rot caused by Phytophthora terrestria Sherb. occurred about as usual in Florida and "was confined mostly to sweet seedling groves and trees on Rough Lemon stock."

Gummosis (cause unknown) was more or less widely distributed in the northern part of the citrus belt in Florida.

Center rot caused by Alternaria sp. was found in 10 of the 87 cars of California lemons inspected, causing an average of 11% decayed fruit. The decay occurred in all stages from slight to complete and affected from 2-30% of the lemons. One car of California oranges also was reported as showing an occasional orange affected with Alternaria.

Brown rot caused by Pythiacystis citrophthora was found by inspectors in at least two cars of California lemons and one car of California oranges.

Stem end rot caused by Diplodia sp. - (See Table 50.)

PINEAPPLE

Fruit rot caused by Thielaviopsis paradoxa (DeSeyn.) v. Hohn.

This was the only pineapple disease of consequence brought to the attention of the Survey in 1919 and practically all of the reports that were received concerned Cuban fruit inspected in some of our larger cities. The following table shows the situation in some detail.

Table 53. Losses to Cuban pineapples from fruit rot in individual cars as shown by markets inspection, 1919.

Place where inspected	Date of inspection	Percentages of decay in individual cars	Severity of decay.
Chicago	Jan. 8	55	Some crates showed 30-85%, mostly complete decay.
"	Feb. 9	45	Range 15-70%.
"	Mar. 12	47	Two-thirds complete decay.
"	" 13	37	Three-fourths " "
"	" 15	22	Two-thirds " "
"	Apr. 14	40	One-half " "
"	" 14	55	" " " 2
"	" 14	60	" " "
"	" 16-18	25	Mostly complete decay.
"	" 16-18	33	" " "
Columbus	" 16-18	40	" " "
"	" 16-18	45	" " "
Chicago	May 5	30	Range 15-65%, 20% complete.
Milwaukee	" 21	10	Affected about 1/2 of each fruit.
"	" 22	6	" " 1/3 " " "
Omaha	" 23	6	Mostly complete.
"	" 23	7	" "
"	" 27	20	" "
Milwaukee	" 28	8	Fruit spotted, occasional complete decay.
Pittsburgh	" 28	15	
New Orleans	" 31	16	
Columbus	" 31	8	
"	June 3	6	Complete decay.
"	" 3	9	" "
"	" 6	15	Mostly complete decay.
"	" 9	10	" " "
"	" 9-11	25	" " "
"	" 9-11	5	" " "
"	" 9-11	5	" " "
Flint, Mich.	" 10	30	Complete decay.

Pleae where inspected	Date of inspection	Percentages of decay in individual cars	Severity of decay.
Rochester	June 10-12	22	Mostly complete decay.
"	" 10-12	10	One-third bad decay involving 1/3 of each fruit.
Des Moines	" 10-12	21	" " " "
"	" 10-12	30	" " " "
Columbus	" 11	9	Mostly complete decay.
"	" 11	13	" " "
Washington	" 13	48	One-half complete decay.
Columbus	" 16	17	Four-fifths completedecay.
Kansas City	" 16	24	
"	" 16	35	
Columbus	" 18	17	Mostly complete.
Pittsburgh	" 19	15	Affected 1/2 of each fruit.
New Orleans	July 23	37	" " " " "
Chicago	Nov. 11	55	Mostly complete decay.
Cincinnati	Dec. 22	12	Mostly at stem end.

FIG

Rust caused by Physopella fici (Cast.) Arth. (Uredo fici Cast.) was reported from Florida (general) loss not so important, occurred late, first report July 3), Alabama, and Texas (prevalent).

Anthracnose caused by Glomerella cingulata (Stoneman) Sp. and Von S. reported from Louisiana (scattered, damage slight) and Texas (Harris County). What was probably the same trouble was reported as Colletotrichum from Florida where it was the cause of occasional loss in Volusia and Gadsden Counties.

Canker caused by Macrophoma - Texas.

Leaf blight caused by Rhizoctonia - Florida.

Leaf spot caused by Cercospora - Hawaii.

DATE

Leaf smut caused by Graphiola phoenicis (Norig.) Poit - Reported from Texas.

Leaf spot caused by Exosporium palmivorum Sacc. - Reported from Harris County, Texas, as occurring in traces and unimportant.

BANANA

Wilt caused by Fusarium, probably cuberse incdoratum (E. F. S.) Brandes occurred in Porto Rico in the usual amounts, causing about 25% injury to the crop, according to J. Matz.

Freckle caused by Phoma musae Carpenter - was reported by Carpenter from the Island of Oahu of the Hawaiian group. The disease attacked the Chinese or dwarf banana almost exclusively, causing serious damage to fruit and leaves. Spraying experiments are being conducted.

LOQUAT

Blight caused by Bacillus amylovorus (Burr.) Trevisan reported as common in Louisiana, injuring a large percentage of trees but causing only slight actual loss.

AVOCADO

Scab caused by Cladosporium sp. was reported about as prevalent as usual but somewhat more common on the fruits than is ordinary. Locally it was considered severe. First report was in April.

Fruit spot caused by Colletotrichum sp. was reported by H. E. Stevens as causing more injury than usual, injuring 10-90% of the crop in local instances. First reported in July.

DISEASES OF NUTS

PECAN

Scab caused by Fusicladium effusum Wint.

Apparently scab was very common in the Southern states on pecan last year. Reports of its occurrence were received from South Carolina, Georgia, Florida, Alabama, Mississippi, and Louisiana. Losses of 10 and 5% were estimated in South Carolina and Georgia respectively. Susceptible varieties were reported from Georgia as follows: Van Diemer, Mobile, Delmas, and Georgia Giant. The Delmas was also reported susceptible in Alabama.

Powdery mildew caused by Microsphaera alni (Wallr.)

Reported common in South Carolina (2% loss), Georgia, Alabama (loss small), and Mississippi (small loss).

Rosette (non-parasitic).

This disease was reported by states as follows:

Alabama: General. Reports from Washington, Marengo, Pike, and Houston Counties.
Arkansas: Reported from southwestern part of state. It is severe on some of the river bottom plantations where hardpan prevents the rise of ground water during dry season. Less on sandy than on dark rich soils.
Georgia: General, about 5% loss in state.
South Carolina: Common, about 5% loss.

Other diseases.

Crown-gall caused by Bacterium tumefaciens Sm. and Towns. - Alabama.
Anthracnose caused by Glomerella cingulata - Georgia.
Leaf spot caused by Cercospora sp. - Louisiana.

WALNUT

Bacterial blight caused by Bacterium juglandis was reported from Alabama and New Jersey. In the latter state it was abundant on English walnuts and the cause of many inquiries, according to M. T. Cook.

Crown-gall caused by Bacterium tumefaciens Sm. and Towns. - Reported from Clarke and Pierce Counties, Washington.

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